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AGRICULTURAL EXPERIMENT STATION

Research in the Service Of Maryland Agriculture

SEVENTIETH ANNUAL REPORT
1956 - 1957

BULLETIN A-92
COLLEGE PARK, MD.
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Research in the Service Of Maryland Agriculture

Seventieth Annual Report, 1956-1957
University of Maryland
Agricultural Experiment Station
College Park, Maryland
Bulletin A-92 June, 1958

University of Maryland
Agricultural Experiment Station

To the Governor of Maryland,
the Board of Regents,
and the President of the University of Maryland

I transmit herewith the Seventieth Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments conducted during the fiscal year ending June 30, 1957, and a statement of the receipts and disbursements for the same period.

I.C. Haut
I. C. Haut,
Director

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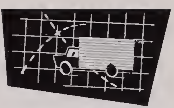
AGRICULTURAL ECONOMICS AND MARKETING



The agricultural economy is rapidly changing. The current adjustment period is characterized by high physical farm output, a large supply of food and fiber, and a cost-price relationship unfavorable to farmers. These conditions reflect a need for more intensive and penetrating economic research and greater application of research findings to operation of the farm business, marketing of agricultural products, and operation of agricultural service agencies.

Study Labor Needs to Produce and Market Tobacco

An average of 27.3 man-hours was required to produce and market 100 pounds of tobacco, 274 man-hours for an acre of tobacco in 1954. These farmers used 72.4 percent of their time on the tobacco crop. A man-equivalent produced an average of 7.3 acres and 7,322 pounds of tobacco.

One man stripped and graded about 70 pounds in a 10-hour day, including taking the tobacco from the barn, moving to the stripping room, grading, regrading and hauling stalks.

Labor efficiency was affected by the size of the farm business, yield per acre and degree of specialization. The larger growers used fewer hours of work per hundred pounds of tobacco.

When the cumulative effect of the factors was considered, those farms which were below average on all 3 factors were the least efficient, using 32.4 hours of work per hundredweight. Those which were above average on all 3 factors produced 100 pounds of tobacco with 21.6 hours of work.

The average value of all labor was $5,468 per farm. Operator's own labor accounted for $3,173 of the amount; hired labor, $1,759; and family labor, $536. On these farms, labor used in production and marketing tobacco accounted for 73 percent of total labor cost on the farm.

(Project A-18-aj)

Survey of Cooperatives Shows Healthy Development

Maryland has a healthy cooperative development. The total net volume of business conducted in Maryland by 80 local cooperatives reporting in 1953-54 amounted to over $65 million. The total gross volume of all cooperatives, including transactions between cooperatives and sales by regional cooperatives, amounted to over $100 million. The average current asset-to current liability ratio for all cooperatives reporting was approximately 4.2 to 1, with 35 percent of the cooperatives reporting having less than 1.5 to 1 ratio, 7.5 percent having between 1.5 to 1 and 2.0 to 1, 32.5 percent having between 2.0 to 1 and 4.0 to 1, and 25 percent having over a 4.0 to 1 ratio. The total net worth as a percent of the total assets averaged approximately 64 percent for the cooperatives reporting. Only 35 percent reported a net worth of less than 50 percent of their total assets, while 37.5 percent reported a net worth of over 75 percent. Current assets, on the average made up approximately 50 percent of the total assets for all the cooperatives reporting in 1953-54.

The greatest deficiency noted among the Maryland cooperatives appears to be among the smaller marketing and related service cooperatives. These organizations appear to be lacking in proper organization and sound business practices.

(Project A-26-al)

Study Sources of Highway Improvement Income

Maryland motor vehicle owners paid from 18 to 42 percent of toll bridge charges and about 87 percent of gasoline taxes in Maryland, 1955-56. They also paid virtually all state motor vehicle titling taxes and registration fees. About 91 percent of titling taxes, 64 percent of registration fees, and 54 percent of gasoline taxes were paid by Maryland owners of passenger cars. The titling tax, and half of the gasoline taxes and registration fees, are dedicated for state road improvements and maintenance, especially for heavily travelled highways and those serving large numbers of out-of-state vehicles. Thus, Maryland vehicle owners will largely be responsible for financing such improvements, with the heaviest burden on those areas or groups having relatively large numbers of vehicles.

Data contained in this study may serve as a basis for keeping a proper balance of tax contributions for highway support between in-state and out-of-state vehicle owners and users, as well as between lightweight and heavyweight vehicle use. It provides guidance for legislative measures necessary to achieve these goals.

(Project A-19-r)

Housewives Prefer Plastic Egg Cartons

Housewives prefer a plastic egg carton over the regular and window type carton, according to a consumer response survey conducted in a retail store. When housewives were asked their preference of 3 cartons on display, namely, the regular, window type and plastic, nearly 70 percent of them preferred the plastic carton; 21 percent indicated a preference for regular; and 7 percent preferred the window type; only 3 percent had no preference.

In giving reasons for their choice of the plastic cartons, housewives said they liked to see the color, size and condition of the eggs they bought. In other words, they liked the plastic carton because of greater visibility. About 60 percent gave as a reason that the carton was more attractive.

Housewives expressed a marked preference for clear plastic egg cartons like this. They said they liked to see the color, size and condition of the eggs they bought.

Another 26 percent were impressed with its durability.

A further check was made of the plastic carton in a controlled matched lot experiment where eggs were placed on display in regular and plastic cartons. Results of this test showed that sales were better than 2 to 1 in favor of the plastic carton over the regular when the price was the same. When the price of eggs displayed in the plastic carton was increased to 3 cents over the regular, housewives purchased eggs in the 2 cartons at about the same rate. This test was conducted for a 4-week period.

Even though tests at Maryland and other stations show that plastic cartons may increase sales of eggs, there are several problems which need to be overcome. Thus far, the cost of the plastic carton is prohibitive for its use in trade channels. A further problem is the difficulty of packing eggs in plastics, especially when the job is done on an assembly line basis.

(Project A-26-am)

Snap Bean Production in Maryland Declining

Snap bean production in Maryland has declined steadily since 1949.

The decline has been most severe in Anne Arundel, Baltimore and Carroll counties. Total bean production in these counties is now only slightly more than half what it was in 1950, and the acreage grown under contract has been reduced even more.

Snap bean production on the Eastern Shore is concentrated in Wicomico and Somerset counties, where production has also decreased, but at a slower rate. Practically all of the processing beans grown in this area are grown under contract with local processors. One variety of bean—Valentine—is also grown in this area for sale on the fresh market.

Adverse weather conditions coupled with extreme price fluctuations have been largely responsible for the decline in snap bean production for the fresh market. The reduction in contract acreage has been due to poor yields and a slight decline in the contract price.

The acreage of beans grown under irrigation has been increasing each year. During recent dry years, yields on irrigated fields were almost double those on nonirrigated fields.

During 1955, considerable time was devoted to studying the adequacy of marketing facilities for snap beans in both the Baltimore and Salisbury areas.

Because of the congested conditions in the Baltimore produce market, producers were frequently required to wait in line for several hours to market their produce. These long delays resulted not only in a waste of the producers' time, but frequently caused serious loss in quality. Needless to say, there was considerable grower and shipper dissatisfaction with the present marketing facilities. As a result of these findings, assistance was extended the Baltimore wholesale produce Market Commission, in the hope a new and more efficient produce market would eventually be built.

(Project A-26-aq)

Survey Made of Slaughter Plants in Maryland

According to a survey made of slaughter plant managers in the Maryland area, most of the animals bought for slaughter were purchased at auction and terminal markets or from dealers and farmers directly. Auction markets were the leading suppliers of veal calves, sheep and lambs for slaughter and ranked second to terminal markets in supplying other cattle. Hogs were bought principally at terminal markets and direct from farmers. About 55 percent of the animals slaughtered were cattle and calves; 37 percent, hogs; and 8 percent, sheep and lambs, during the year 1955.

Of the 37 plants surveyed in Maryland, 11 reported buying some or all of their purchases at the plant. These 11 plants reported having bought 12 percent of their cattle, 7 percent of their calves, 29 percent of their hogs, and .5 percent of sheep and lambs at the plant. Livestock was bought principally from Maryland and nearby states.

Of the total red meat production processed in the plants surveyed, beef accounted for 73 percent, pork 18.5 percent, veal 7 percent, and mutton and lamb approximately 1.5 percent.

The distribution of red meat in Maryland shows 63 percent to retailers, 19 percent to wholesale channels, 13 percent to consumers, and 5 percent to institutions, including government. There was some variation between the kinds of meat and the relative distribution going to each market outlet. For example, retailers directly receive more than 80 percent of the veal, mutton and lamb distributed and only 53 percent of the beef.

The grades and weights of animals slaughtered by different plants varied considerably depending on the type of market served. Very little custom slaughtering was done at slaughter houses included in the survey.

(Project A-26-an)

arketing of Forest Products Studied

According to information obtained rom 250 firms handling forest prod-cts in Maryland, most of the first andlers received their supply from ithin a 25-mile radius of their mills. ayments made to producers were sually based on estimates of visual rade, location of the area, and use. ifty-five percent of all handlers re-ed on verbal contracts in their pur-hase of timber. Sixty-five percent f the firms operated on a year-round asis, and 20 percent had plans for moving to new locations at the time of the survey. Additional information was obtained on capital investment, cost of operation, inventory turnover, and number employed at the mills.

Results of this study will be useful to farmers in appraising the market value of timber and broaden their opportunities for marketing forest products.

(Project A-26-ah)

AGRICULTURAL EDUCATION

Agricultural education research is primarily concerned with helping rural educators to do a better job. The project reported below concerns a most vital phase of rural education, making farms a safer place on which to work and live. This study is designed to point the way towards a more effective method of educating farm people to be conscious of the present high farm accident toll and to help them help themselves to eliminate accident hazards.

ducational Campaigns Effective in Promoting Farm Safety

Farming is more dangerous than ny other occupation except mining nd construction work. It leads all ccupations in number of fatalities since farmers outnumber miners nd construction workers). About 4,000 farm residents die in accidents very year. Several non-farm occupa-ons entail more accidental injuries ut farm accidents are more serious.

Believing that farm accidents can best be prevented through education, the Agricultural Education Department has undertaken a study to identify the causes of accidents on Maryland farms, and to develop teaching techniques that will reduce hazards, make rural people safety conscious and result in fewer farm accidents.

Through the cooperation of the

vocational agriculture teachers and students in 6 schools, 288 farms were surveyed in 1956 for accident hazards. On these farms 3,203 hazards were identified and 1,786 were corrected. Accompanying this activity, the vocational agriculture departments carried on safety instruction through classwork, exhibits, newspaper articles, radio and TV programs. Following the safety campaigns a record of accidents on the farms surveyed was kept for the ensuing year. During this period the 288 farms reported only 6 accidents.

To measure the effectiveness of the educational campaigns, accident records were kept on another group of 320 farms in 6 other communities where no safety campaign was conducted. These alternate farms and communities were located so that they were as similar to the first group as was possible. Here again, accidents were reported by vocational agriculture students through their Vo-Ag teachers. During the year, a total of 28 accidents were reported on these farms. The greatest number of accidents occurred harvesting hay and corn crops.

A further comparison of the 2 groups shows that in the first group there was 1 fatality and 4 injuries, with a time loss of 116 days and medical expenses of $3,755.60; whereas in the second group 2 people were killed and 18 were injured, with a time loss of 305.5 days and medical expenses of $2,930.00. The large medical expense in the first group was due to a severe tractor accident that cost 1 man $3,700.60 in hospital, doctor and other medical expenses. The property damage in the first group was $2,700.00, while in the second group it was $4,844.50.

While this study will be carried on for another year before complete findings are tabulated and conclusions drawn, results thus far indicate that safety instruction does pay off in reduced accidents and losses.

ANALYSIS OF ACCIDENTS IN TWO FARM GROUPS*

Item	*Group #1*	*Group #2*
Number of farms in study	288	320
Number of Vo-Ag departments	6	6
Number of accidents	6	28
Number of people killed	1	2
Number of people injured	4	18
Days work lost	116	305.5
Medical expense	$3,755.60	$2,930.00
Property damage	2,700.00	4,844.50

* Group #1—Farms in communities conducting safety campaigns.
Group #2—Farms in communities not conducting safety campaigns.

For the second year of the study, 392 farms in 7 communities have been surveyed and 2,739 hazards out of 4,579 found have been corrected. Three of the communities are repeats from last year's study, while 4 are conducting safety campaigns for the first time. Accident records will be kept on these farms for one more year.

A similar number of other farms in communities without safety campaigns are again being studied for accidents. None of the farms in this second group are in communities that were included in last year's study. The expanded study is expected to yield more information on the causes of accidents and the effectiveness of educational techniques used for their reduction.

(*Project T-4*

AGRICULTURAL ENGINEERING

Efficient farm buildings and the equipment which makes them effective livestock shelters or curing and storage structures for farm crops are important phases of research in the application of engineering to agriculture. Control of temperature and humidity are ever-important as are arrangement of the structure and auxiliary equipment to facilitate handling of materials.

Curing and Handling Maryland Tobacco

Studies were continued on determining optimum conditions for curing and storing Maryland tobacco and the application of these findings to standard size barns.

Tests were conducted on curing tobacco under constant conditions of temperature and humidity. The conditions studied were, a constant dry bulb temperature of 80° F. with constant relative humidities of 90, 80, 70, and 60 percent for different treatments.

After considering all factors the best cure seemed to be at 80° F. and 80 percent relative humidity. Some of the results were: The value per acre was highest for 80 percent humidity, approximately 10 percent less for 60 and 70 percent and 25 percent less for the 90 percent condition. The yield per acre of cured tobacco was about the same for all treatments, except the 90 percent condition which was approximately 25 percent less. Of this, approximately 17 percent was due to leaves discarded because of severe houseburn, and 8 percent was due to greater weight loss during curing. The 90 percent condition averaged several dollars more in value per 100 pounds than did the other conditions. The major portion of the grades of the 60 percent conditions were placed in the "M" (mixed color) government grades due to the predominance of yellow color which is not desired.

The duration of burn was very good for all treatments. However, the 90 percent condition burned much longer than the other treatments. In all cases when the tobacco was houseburned the duration of burn increased.

It has been found that Maryland tobacco generally has to be exposed to a relative humidity condition of 83 percent or higher to attain a good condition for stripping and handling. The temperature has little effect as long as it is above freezing. This condition will be lower for tobacco that was cured too fast and higher for tobacco which houseburned during curing. Maryland tobacco can be handled when exposed to lower humidities. However, care must be taken or damage will occur. It has been found that the moisture content of Maryland tobacco should be between 18 and 22.5 percent for good handling.

(Projects R-11-d, R-11-e)

Develop Machine to Help Harvest Sweet Potatoes

One of the problems of digging sweet potatoes is the volume of vines found on popular Maryland varieties. A machine was designed, built and tested which might sufficiently tear them up, to make possible the use of a standard potato digger. Except for a few which were parallel to the row, the vines were almost completely destroyed. Power required seemed excessive, and forward speed quite slow. The few remaining vines prevented effective separation under the wet digging conditions of the 1956 season.

(Project R-18

Drying Shelled Corn with Unheated Air

The work with drying shelled corn with unheated air was repeated with corn of higher moisture content. An extended period of almost continuous cloudy, rainy weather followed placing the 26.8 percent moisture corn in the bins. Drying was slow, especially in those bins with humidistat controlled blowers.

Examination of the top of the bins showed that with 6 and 8 C.F.M. (cubic feet per minute) per cubic foot of corn, with the blowers operating continuously, the corn was in perfect condition. With only 4 C.F.M. per cubic foot, some mold was evident. With humidistat control of the blowers, with the humidistat set to operate below 80 percent relative humidity, all bins showed considerabl mold with the lower air volumes being worse. Depth to which the mold occurs will be determined when th bins are emptied.

(Project R-17

Handling Partially Cured Chopped Hay With Air

A great deal of work this year has been a continuation of previous years' work on developing a method of feeding a uniform flow of partially cured chopped hay into the system. The blower boot on a commercia forage blower was rebuilt to accommodate the discharge from bot blower and volume fans. Size of th throat from the volume fan was con

Irrigation plots planted to tobacco and corn, and left bare.

rolled so that inlet velocity and volume of air could be varied.

Even though considerable effort vas made to feed the blower with an ven flow of material, there were eriods when very small amounts of naterial were followed by large mounts. This was due in part to he auger-type feed on the blower. This type of feed did not give as uniorm a flow of material as did the belt type previously used.

The modification of the forage blower and relocation of the point of entry for auxiliary air improved the characteristic of hay entry into the system, but has not been completely satisfactory. There was considerable plugging in the blower as well as in the pipe beyond the blower.

(Projects R-16, NE 13)

AGRONOMY

The agronomy research program is of necessity, highly diverse because of the relatively large number of different field crops of importance in the State and the variable types of soil on which these crops are grown. Each individual combination of a crop and a soil presents problems different from all other combinations. To solve these problems every attempt is made to maintain an effective balance of fundamental and applied research.

Emphasis throughout the research program is on efficiency of production. Whether it be the breeding of an improved variety, the development of better cultural practices, or fundamental studies of crops and soils, increased efficiency in farm production is the overall objective.

Progress in Soybean Breeding and Cultural Studies

Variety testing in Maryland since 952 has formed the basis for varital recommendations to farmers. Farmer interest and acceptance of ew varieties has been good. Participation in the cooperative testing of new strains insures the State of the very latest in new, improved varieties. Two new strains are now scheduled for release in 1958 and 1959.

The first two strains from the Maryland breeding program were entered in regional tests for 1957.

Variety and date of planting studies have indicated the need of more critical data on the developmental phases of the soybean plant. Cooperative studies with Delaware and Virginia concerning these growth phases are now in progress.

Preliminary results of a rate o seeding study indicated no difference in yield of soybeans when plante at varying rates, 5 to 50 lbs. per acre

Preliminary results of a lodging experiment showed no appreciable effect of lodging upon either yield o quality of soybeans.

(Project B-43

Many Corn Hybrids Perform Well in a Good Season

In 1956 Maryland had one of its best corn seasons on record. Excellent yields were obtained in evaluation tests as well as in the State generally. All double-cross tests averaged well over 100 bushels per acre of good quality corn. Under these conditions many commercial hybrids performed quite satisfactorily.

Although the season was generally too good to permit the exposure of many varietal weaknesses, some comparative observations were of value. Good readings were made for differences in stalk strength in 2 of the tests. Open pedigree hybrids with good stalk quality were Pa 602, Ohio W64, NJ 8, Pa 807, US 505, and UPI 648. Stalk rot continues to be costly in this age of mechanical harvesting Some hybrids are superior to other in resistance, but much improvemen is needed. Renewed effort is bein made to breed more resistance int parental lines.

Interesting observations were mad on blackbird damage in the Ken county test. Saturated feeding b countless blackbirds prior to harves caused grain losses up to 16 bushel per acre. Varietal preference was consistent among replicates, and was no closely related to maturity. Ohi W64, Pa 807, Pioneer 312A, an Moews 500A had the least damag in this test, but proof of their superiority requires more observatio

(Project B-5

Better Wheat on Fewer Acres

Although the wheat acreage in Maryland has decreased, this crop is still the State's most important small grain. Not only is it a major cash crop, but it also produces much-needed straw, and fits well into the rotation systems used on many farms. Knowledge of the specific adaptation and use of available varieties is important. This project continues to provide data on all new varieties likely to be useful in Maryland.

In 1956 tests, yields ranged from 31 to 45 bushels per acre, with a number of varieties closely groupe at the top. Knox continued to giv promise as a beardless early variet with good productivity, good grai and straw quality, and comparative little mildew. Dual, the Hessian-fl resistant variety from Indiana, pe formed well.

A significant interaction was foun between fertility level and variet Knox did well at high levels, whi Thorne did relatively well at lo levels.

(Project B-6

provement in Feed Grains

Better varieties of feed grains—win- r barley, winter oats, and spring ts—would provide a more depend- le feed supply for the State. This oject includes evaluation work on l these crops.

Kenbar and Hudson barleys con- nued to show good productivity, od bushel weight, and fair to good sease resistance. Strong, tough awns, however, limit their popularity. Because of this characteristic, they are not replacing the older variety, Wong, as rapidly as yield superiority should justify.

LeConte winter oats continued to show good straw strength. Clarion and Craig spring oats were outstanding in 1956.

(Project B-67)

eeding for Mildew Resistance in Wheat and Barley

Mildew on wheat and barley has en of serious concern in recent ars. Increased straw growth as a sult of production on better fer- lized land undoubtedly has accentu- ed damage from this disease. Al- ough good varieties of barley such Wong, Kenbar and Hudson are re- stant, most of our popular wheat rieties show very little resistance.

This project has the dual objective studying inheritance of mildew in rley and breeding mildew resist- ce into popular wheat varieties useful in Maryland and the northeastern states.

By utilizing both greenhouse and field plantings, locally adapted but mildew-susceptible varieties of wheat, namely, Seneca, Tayland, Anderson, Pennoll, Knox and Leapland, were crossed with 2 to 5 resistant but unadapted strains. From these crosses, effort will be made to select new commercial strains that are both productive and resistant to mildew.

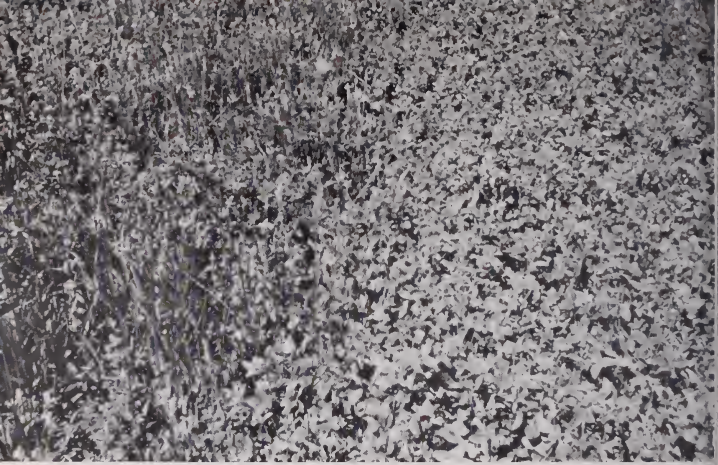
(Project B-69)

esapeake—A New Red Clover—To Be Released

Red clover continues to be an im- rtant legume in the agriculture of aryland, particularly since alfalfa is tacked so severely by several insects. nnscott and Kenland varieties are tisfactory in the western and north- n counties, but neither perform ell on the Eastern Shore. Local ains do well in this area, but seed pplies are inadequate. Work is un- rway to combine desirable charac- ristics of several superior local ains with lines which have been lected for resistance to southern an- racnose and have shown a high de- ee of perennialism.

As a result of the testing program running concurrently with the improvement work, superior local strains have been obtained. Stevens is one of these strains that has looked exceptionally good throughout Maryland as well as neighboring states over the past several years. Because of this superiority, Stevens red clover is being released as a new variety by the Maryland Agricultural Experiment Station under the name "Chesapeake." Seed was sent to California for increase, and should be available for 1958 plantings.

(Project B-56-a)



On the right is Chesapeake, a new red clover variety being released by the Maryland Station; on the left is Kenland.

Breeding for Improved Ladino Clover

Efforts to improve Ladino clover through breeding were continued. Experimental findings and farmer experiences have shown that although this legume possesses many advantages for pasture use, it is lacking in disease resistance, drought tolerance and competitive ability with tall growing grasses. Because of these weaknesses, it is often difficult to maintain Ladino clover for any length of time.

A number of superior plants selected from several thousand will be further evaluated at various locations in the Northeast on the basis of their progeny performance.

(Project B-56-g)

Better Forages Tested in Several Locations

Variety tests of alfalfa, Ladino clover, red clover, orchardgrass, tall fescue, Bermudagrass, sorghum, sudan grass, pearl millet, tall oatgrass, smooth bromegrass, crimson clover, annual lespedeza, and vetch were conducted at several locations in the State.

Chesapeake red clover, a new variety to be released by the Maryland Agricultural Experiment Station, continues to be the leading red clover in both yield and persistence. Several local strains look good.

Williamsburg and Narragansett alfalfa continue to look good. DuPuits alfalfa, of French origin, not only looks promising as a short-term alfalfa, but is maintaining production into the third and fourth harvest years. DuPuits is a coarse-stemmed alfalfa that matures about 1 week earlier than most other alfalfas in this area.

Tests indicate considerable potential for Hybrid #1 pearl millet as a combination grazing and silage crop for summer production in Maryland. Several new sorghum varieties may also have possibilities for silage.

Midland and Greenfield Bermudagrass continue to look good at 3 locations in the State while Coastal and Suwanee varieties were virtually eliminated during the 1956-57 winter period.

(Project B-56-l)

Improved Late-Maturing Orchardgrass Needed

In studies just completed, late-maturing strains of orchardgrass grown with alfalfa for hay produced good yields of high quality forage. Considerable emphasis has been placed on the development of best late-maturing types to be used primarily with alfalfa for hay.

A number of orchardgrass plants have been isolated which have the range of maturity desired. Many of these have good aftermath growth, leafiness, vigor and resistance to leaf diseases. These will be tested further.

(Project B-56-i)

New Pasture Combinations Look Promising

Dairy and beef cattle numbers in Maryland have steadily increased. So have total feed needs. The search for more productive pasture combinations, adapted to a wider range of conditions, becomes increasingly important if these needs are to be provided economically. Extension of the grazing season beyond its present normal limits, both in the spring and fall, offers encouraging possibilities.

In order to further test pasture combinations which may satisfy these conditions, Kentucky bluegrass-timothy-white clover, orchardgrass-Ladino clover-red clover, reed canarygrass-Ladino clover-red clover and Midland Bermudagrass-crimson clover pastures were evaluated for beef production using yearling Hereford steers. Beef production the first year after establishment was highest for

Hereford steers grazing rye in pasture trials. Crimson clover is in the foreground.

Bermudagrass followed by orchardgrass, reed canarygrass and then bluegrass. Beef production and carrying capacity of Bermuda during the late summer was nearly 3 times as large as any of the other mixtures. Only in the early spring were these mixtures superior to Bermudagrass.

Rye and crimson clover were seeded in Bermudagrass paddocks in the fall of 1956 in an effort to extend the grazing season. Pasturing started 20 days earlier in the spring on rye seeded in Bermudagrass sod than on the other pasture mixtures. Two hundred and twenty pounds of beef per acre were produced on the rye during this period. The Bermudagrass made considerable growth, while the rye was still productive. It appears that the transition from rye to Bermuda can be made with little reduction in animal numbers or beef gains.

(Project B-56-j)

Precision Seeding and Good Management Key to Good Forage Stands

The most productive pasture and hay stands do not occur naturally—they must be planted. Getting a good stand is one of the most important steps in a productive and profitable forage program.

Cooperative studies with the U. S. D. A. Agricultural Engineering Research Division, Beltsville, Maryland, have been conducted in order to learn more about the problems of forage establishment and management of new stands.

Band seeding studies with alfalfa and bromegrass resulted in good forage establishment. Findings in 1956 were intermediate to those obtained in 1954 when band seeding resulted in substantially better forage stands, and those obtained in 1955 when band seeding produced no better stands than the broadcast, cultipacker method of seeding. From results thus far, the greatest advantage for band seeding appears to be where conditions unfavorable for establishment are encountered. In short, it takes some of the gamble out of forage establishment.

Good management of seedling stands is a must if they are to become productive and to persist. Two to 3 clippings in the seedling year resulted in the best orchardgrass-Ladino clover stands. Alfalfa-bromegrass and birdsfoot trefoil-timothy stands were superior when only a single deferred cutting was made. When only 1 clipping was made on orchardgrass-Ladino clover, best results were obtained with a deferred cutting. Alfalfa and trefoil stands were best if not clipped at all where weeds were not a problem. Stands were reduced substantially under conditions of heavy competition, whether from weeds or the companion crop. This was particularly true in the case of Ladino clover.

(Project B-56-m)

Good Management Makes High Quality Alfalfa Hay

Alfalfa acreage in Maryland increased to an all-time high in 1955 of 90,000 acres. A better understanding of conditions necessary for its growth, and availability of seed of superior varieties have largely accounted for this increase.

In recent years we have learned a great deal about managing this excellent plant in order to obtain high yields of nutritious forage. However, more time is needed to fully answer the questions on yield, forage quality and stand persistence with regard to management practices under conditions in the humid East.

Alfalfa harvested at the early bud stage of growth will produce higher quality forage than when cut at a later date. However, yields may be lowered and stands damaged by such treatment. The number of harvests made during the season and the date of the last harvest also affect yield and persistence of stand. Should a pure alfalfa stand and an alfalfa-grass mixture be managed identically? These factors are being studied in an experiment which is now in its third harvest year.

Preliminary results from this study indicate that spring harvests at the early bud stage, and subsequent cuttings made at half-bloom have reduced the alfalfa stand when grown with orchardgrass, but not when grown alone. Early cutting resulted in slightly lower yields, but forage quality was much higher than from later first cuts.

In most of the cutting treatments, orchardgrass-alfalfa yields were higher than alfalfa alone. Lodging was less severe when alfalfa was grown with a grass, and as a result a much larger percentage of leaves was saved.

With a 3-cutting system, little difference in yield or stand persistence was found between early, medium or late fall harvests whether seeded alone or with orchardgrass.

(Project B-56-n)

Compare Legume Nitrogen vs. Fertilizer Nitrogen

Five grasses grown with Ladino white clover were each fertilized with 0, 50, and 100 pounds of nitrogen per acre. Much of the clover was lost, even on the non-nitrated plots, mainly because the experiment was located on a light sandy soil with low water holding capacity. As a result, yields were generally low. However, these same 5 grasses grown alone in this study and nitrated with 100, 200, and 400 pounds of nitrogen per acre produced much higher and more uniformly distributed yields. This further indicates that there are situations where it would be more economical to supply nitrogen in the form of commercial fertilizer rather than attempting to maintain a legume stand for that purpose.

In other tests where soil moisture was more nearly adequate than in the above experiment, clover was maintained and yields were good. Under these conditions it probably would be cheaper to supply nitrogen in this manner rather than applying commercial fertilizer.

(Project B-56-o)

Band Seeding Improves Late Seedings of Alfalfa

Failure to obtain good stands of legumes in this state may be due to several factors. One of the important ones is competition from weeds in late fall and early spring before legumes become well established.

In an attempt to find a remedy for this problem, a series of experiments was set up to determine the effect of fertilizer and seed placement at different dates on the establishment of alfalfa.

Preliminary results indicate that although September would be better, from the weed control standpoint, it is too late for good alfalfa establishment. Not enough root growth is obtained to give alfalfa a good start the following spring. Seedings in July generally were good, provided moisture was adequate. August seems to be the best month for seeding alfalfa.

In general, it made little difference whether the seed and fertilizer were placed in rows or both broadcast. Seedings in September were the exception. The extra boost given by placing the fertilizer directly below the seed row tends to improve the stand. It is not, however, equal to any of the August seedings. If a farmer were forced to seed late, the best method would probably be to band fertilizer directly below the seed.

(Project B-58-c)

Fundamental Research Aids Understanding of Herbicidal Action

Fundamental studies on the action of CIPC inside plants and the effect of external (environmental) factors on its effectiveness continue to add to knowledge of the behavior of this compound. Previously it was found that CIPC increased the amount of available carbohydrates found in plants. The present studies indicate that this is probably due to increased phosphate activity. This increased activity occurs in both roots and shoots of corn.

Moist soil was used in 1956 to study the effect of various factors on the movement of CIPC in the soil. Air dry soils were used in previous years. It was found that soil moisture level, soil texture, soil pH and organic matter content all had an influence on CIPC movement. Soil moisture had a strong effect, the chemical going deeper in a moist soil than in a dry one. Soil type had an effect, but it was not as clear-cut. The chemical apparently moved deeper in a clay than in a sandy loam. CIPC went deeper where the soil pH was 4.2 than where it was 7.1. Soils low in organic matter resulted in greater downward movement of CIPC than in soils of higher organic matter content.

(Project B-58-d)

New Weed Control Chemicals Highly Promising

A new class of chemicals, the 2,4-D butyrics (or 2,4-DB), appears to offer considerable promise for weed control in alfalfa. The 2,4-DB did a good job of controlling mustard, yellow rocket and wild turnip during the winter of 1956-57 in seedling alfalfa with little harm to the legume. Prior to this time there has been no chemical that could safely be used to control these cruciferous winter annual weeds in alfalfa. The butyrics may be able to do this. No chemicals were found to do a satisfactory job of controlling German knotgrass in alfalfa, but CIPC and Dinitro show promise.

Several chemicals were applied pre-emergence in corn or soybeans for weed control. 2,4-D continued to be one of the better chemicals for broad-leaved weed control. However, amino triazole and various substituted benzoic acids also looked very good. For grass control Randox and the substituted urea compounds were best. In soybeans Randox again looked good, but the benzoic and urea compounds severely injured the beans. Alanap 3 and the butyrics gave fair grass and broadleaved weed control. Dinitro and PCP did not look as good as in the past, but CIPC gave better weed control than usual.

For Johnson grass control, split treatments with 15 pounds of Dalapon per acre continued to look the best. Single treatments with Dalapon did not do as well. Polychloro benzoic acid was not successful.

Amino triazole showed possibilities as a one-shot treatment for Canada thistle control.

Three pre-emergence and 5 post-emergence chemicals were compared for effectiveness in controlling crabgrass in turf. Neburon, Alanap 1F and Crag 1 applied pre-emergence gave fairly good results, but at least 1 retreatment was needed with each. Of the post-emergence treatments, disodium methyl arsonate looked the best. PMA and Potassium cyanate were also fairly effective.

(Project B-58-e)

Climatology Studies Initiated

Studies of climatological relationships to plant growth and of supplemental irrigation of tobacco and forage crops in relation to climatic factors were recently undertaken. Principal objectives of these investigations are: (1) to compile and analyze climatic variables, especially the frequency, intensity and duration of drought periods, (2) to develop a drought forecasting service for farmers, and (3) to intensively study moisture requirements of individual crops at their several stages of development.

From May 24, 1956, to May 1, 1957, weather data from 17 Maryland weather stations were transferred to 168,805 key punch cards. Verification of about one-third of the cards was made, but no analyses were undertaken. This work was supervised by H. H. Englebracht, State Climatologist.

Computations of potential evapotranspiration were made for the growing season of 1956 from data collected in a pilot study conducted at the Tobacco Farm.

A standard weather station and Class A evaporation station were put in operation on May 1, 1956. A recording rain gauge, hydrothermograph and soil thermograph were installed. Other equipment planned for use are an Eppley pyrrheliometer, Johnson neutron soil moisture counter, actinometer (solar radiation counter) and a 16-point Micromax for soil and air temperature measurements.

Legume and grass plantings were made in the fall of 1956 to initiate that phase of the irrigation studies. Gypsum block readings were taken on all tobacco plots until harvest time. Agronomic data indicated no response to irrigation of tobacco, but significant differences were obtained from various spacings and varieties.

(Project BOQR-84)

Greater Effciency in Tobacco Fertilization

Extreme treatments, such as delaying fertilizer applications until 3 weeks after planting tobacco, may prove successful once in 5 or 10 years. Such a year was 1955, when heavy early rains caused leaching, and the nitrogen supply was replenished by delayed fertilization. By contrast, 1954 was dry throughout the summer, and delays in application were disastrous. Highest yields were obtained with early placement of 1,500 pounds per acre of 4-8-12 fertilizer in bands. During the remaining 4 years of the test, rainfall was nearer normal in amount and distribution. In those years, the application of 75 pounds per acre of 4-8-12 at planting time, and 750 pounds as a sidedressing, proved superior to either extreme treatment.

(Project B-60

Ten Years of Research Completed on Tobacco Management Practices

Extended study with continuous tobacco has given positive information with respect to the effect of winter cover crops and management on tobacco production. The following conclusions are substantiated by these tests, conducted cooperatively with the U. S. D. A. Soil and Water Conservation Research Division at Beltsville, Maryland:

Ridged rows, laid out on contour grade to reduce erosion losses, yielded the same as flat cultivated tobacco in dry years, and increased yield 8 percent to 25 percent in wet years. The yield increases in wet years and absence of adverse effects in dry years constitute a strong recommendation for this conservation practice in tobacco farming. Drainage benefit from ridged rows may have particular value for irrigated tobacco wher irrigation and subsequent rainfal combine frequently to produce undesirably wet conditions.

Winter cover crops, tested in rotation with tobacco on sandy land were ryegrass, vetch, or vetch in mixture with wheat, ryegrass or rye. Ryegrass alone did not increase yield of tobacco significantly over those o continuous tobacco without a winte cover crop. Vetch alone increase yields but produced a low quality tobacco. Satisfactory yields and qualit of tobacco were maintained with th mixed cover crops.

Late plowing (about May 15) gav

Rye and vetch were plowed under in this plot. It has good tilth, with lots of coarse organic residues mixe throughout, and will grow a good crop of tobacco. The ridged rows will reduce erosion and prote against "drowning" in wet years.

onsistently higher yields of tobacco han early plowing (about April 15) of these same mixed winter cover rops. The late-turned tobacco averaged 1460 pounds per acre and the early-turned, 1284 pounds per acre. The advantage for late-turning held even in dry years where the increased growth of the cover crops presumably reduced the stored moisture supply in the soil.

The increased organic residues from late-turning kept the soil in the late-turned plots in better condition than the soil in the early-turned plots.

Right Combinations of N_2 and Cover Crops Give Best Tobacco Returns

A farmer can vary the rate of nitrogen fertilization for tobacco to obtain nearly maximum results under a wide variety of cropping conditions. If vetch produces an unusually abundant growth, either alone or in mixtures, all nitrogen can be omitted from the fertilizer. For normal growth on sandy soils, 20 to 30 pounds per acre of nitrogen should be applied following a winter cover crop of mixtures of vetch with either wheat, rye, oats or ryegrass. Also, if legumes fail, or if wheat or ryegrass are seeded alone, extra nitrogen should be supplied to bring the total to 60 to 80 pounds per acre. In that case, it may be profitable to plow under half of the nitrogen to aid in decomposition of the cover crop.

(Project B-68)

Better Tobacco in the Making

Improved strains of Maryland tobacco resistant to wildfire, rootrot and mosaic are being developed. Of these strains, 3 were equal or superior to the best common varieties in yield and acre value in 1956. The need for improvement in quality without sacrifice of yield has increased the complexity of the disease breeding program. It appears that some lines meeting all the qualifications listed will soon be available for farmer use.

(Project J-95)

Phosphate Sources Compared

Over a 10-year period, rock phosphate produced less wheat in a wheat-corn rotation than did superphosphate, calcium metaphosphate, or fused rock phosphate. This was true even when 4 times as much P_2O_5 was applied in the form of rock phosphate as in the other forms.

After 10 years, this land was placed in a 3-year rotation where the phosphate treatments were continued and increased levels of nitrogen and potash were used. Yields of wheat from the rock phosphate plots which had received 4 times the amount of P_2O_5 as the other areas approached those from the best superphosphate plots after 14 years of rock phosphate treatments.

Soil from the land that received these various phosphate treatments was used to evaluate different phosphorous soil tests. A Maryland-developed test and 2 others were found to be good when tested with rock phosphate treated soils. Others did not give reasonable answers.

(Project O-45-b)

Alfalfa Requires High Potash

One of the problems that arises in production of alfalfa is the question of the most effective time to fertilize. Is it better to fertilize in the spring or the fall?

Studies are underway in an attempt to find answers to these questions. Certain practices are beginning to show changes. Alfalfa grown on Beltsville soils requires more than 400 pounds per acre of 0-10-20 or 40 pounds per acre of 0-20-20 in th spring to prevent it from enterin the winter with an amount of potas in the tissue below the critical level

As potash often determines th longevity of the stand, it is suspecte that continuation of such fertilize practices might reduce stands.

(Project O-51

Potassium Soil Tests Studied

Large amounts of potassium are usually present in soil. Quantities often range from 10,000 to 50,000 pounds per acre in the furrow slice alone. All of this, except as much as perhaps 100 pounds, remains unaffected by plant growth each year. This 100 pounds of potassium is maintained in the soil in a form available to plants by a special devise known as the cation exchange system. Some soils quickly replenish the 100 pounds as it is removed by plants from the cation exchange system; others do not. Obviously any method that could measure this replenishin ability of soils would be beneficial i determining when the soil's supply o potassium to the plants is likely t run low. A thermal soil test whic had been proposed as the solution t this problem was studied. The results indicate that the test in its present state is not always satisfactor and either the test should be modified or a new test devised. Studie conducted during 1956 suggest certain modifications that could b made to make the test more usefu

(Project O-5

Fundamental Mineralogy Studies Aid Characterization of Soils

Soil mineralogical studies are being completed on 6 important soil types of Maryland. The clay fractions in particular are now being characterized by X-ray diffraction, differential and integral thermal analysis and chemical properties. Final adjustment and calibration of the thermal balance and differential thermal apparatus were made and some 50 successful runs were completed. Interpretations and analyses of the graphs obtained are now being made. Results from these basic studies will provide valuable guidance to soil management practices and fertilizer and cropping recommendations.

Two major difficulties were encountered during the year. The firs was concerned with thermocouple being retired prematurely in the differential thermal apparatus. Protective coatings of magnesium oxide an cement failed to prolong the life c the thermocouples and did not giv accurate responses to temperatur changes. A 22-gauge chromel-alume wire is now being used which las about 25 runs in comparison with th single runs previously obtained wit 28-gauge wire.

The second difficulty was in the interpretation of X-ray patterns c clays. Base exchange capacity of ce ain samples was incompatible with heir type of clay minerals. Montnorillonite was suspected to be reponsible for the base exchange caacity values but it was not detected n the X-ray patterns. A method proosed recently by Tamura was used uccessfully in expanding to 18A° the nontmorillonite which usually colapses to 14A° in our soils. In addion to vermiculite and illite some of our Maryland soils also contain montmorillonite in detectable amounts, especially in the dark superficial A_1 horizons of wooded soils. These results indicate a very favorable interaction between organic and mineral matter in soils whereby montmorillonite, a mineral with a high base exchange capacity, is being produced.

(Project O-54)

ontinuous Wheat Increases Soil Aggregation and Organic Matter Content

Continuous wheat in a cropping ystem experiment at the Plant Reearch Farm, has been more effective han the common 3 and 4 year rotaons in increasing soil aggregation nd organic matter content. At the ame time, it has averaged 34.3 bu. f wheat per acre during the 4 years his experiment has been in progress. espedeza was seeded in the wheat ach spring and made considerable rowth after the removal of the heat in July. The land was preared by disking and was not plowed during this experiment. This cropping system would have a place on cash grain farms that have erosion problems.

Other studies are in progress on factors affecting the formation and destruction of soil aggregates. Soil aggregates are important because unstable aggregates are associated with tilth problems in the soils. Much of this work is being done in the laboratory and has not progressed far enough for definite conclusions.

(Project O-56)

rederick County Soil Survey Progresses

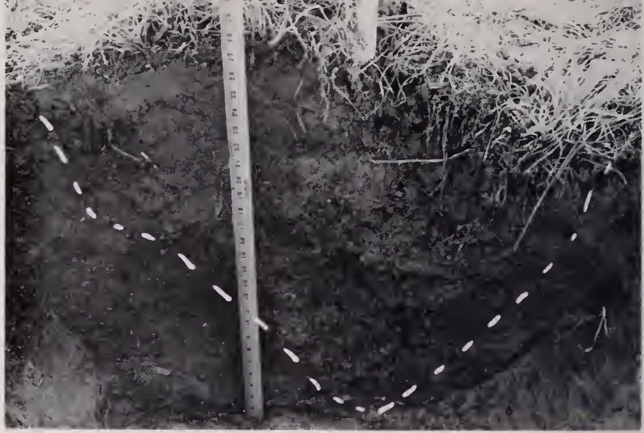
Cooperative work was continued ith the Soil Conservation Service in he correlation of soils in Frederick ounty. It is expected that the soil urvey report and map of this county ill be published in 1958 by the Soil onservation Service.

During the summer and fall of 956, 15 sites were studied in detail ith respect to soil type, vegetation, genesis and morphological characteristics. The information gathered will form the basis of an interpretative system whereby all existing data characterizing these soils will be used to predict their behavior under selected crops and specific management systems. More efficient use of soil maps and reports will thereby be insured.

(Project O-48)

ıbsoiling Gave No Increase in Yield in 1956

No increase in yields of corn in 956 were obtained from subsoiling n cooperative studies with the U. S. . A. Soil and Conservation Research Division at Beltsville, Maryland. These studies were conducted on Beltsville silt loam, Penn silt loam and Ashby loam soils. Subsoiling in



The triangular breakout caused by subsoiling to a depth of 22 inches, on a 42-inch spacing, results in an average increase of only 6 inches in depth of tilled soil. The white stake to the right of the yardstick marks the subsoiler slot.

the fall preceding corn was done on 42-inch spacings to a depth of 22 inches.

Rainfall in 1956 was ample and well distributed to meet the requirements of the corn crop. Yields ranged from 56 bushels per acre on Ashby soil to 83 and 106 bushels on the Beltsville and Penn silt loams. Moisture measurements indicated that the corn did not draw as heavily on subsoil moisture in 1956 as it did in 1955 when subsoiling increased yield from 52 to 61 bushels per acre on the Beltsville soil. Wheat that followed corn showed no response to subsoiling.

Seed Labeling More Accurate

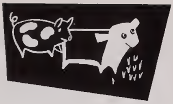
Poor stands of any crop cause heavy losses to the farmer. Good seed is an important safeguard against such losses. Farmers who read the tag or submit seed samples for analysis are using means available to them to prevent the purchase or planting of poor seed.

The quality and labeling of seeds offered for sale in Maryland were further investigated in 1956. Inspectors collected 433 samples of seed at various wholesale and retail outlets in the State to see whether they were tagged as required by law. The completeness and accuracy of the tagging of these samples were considerably higher than last year and the 1953-1956 average.

The number of seed samples submitted to the laboratory by farmers and seedsmen of Maryland was the largest on record. As of May 15, 1957, a total of 4,072 samples had been received for analysis. This phase of the work has advanced rapidly during the last 3 years, due largely to the more active seed program with farmers and seedsmen.

(Project N-10)

ANIMAL HUSBANDRY



Practical animal husbandry involves the use of knowledge gained through research, and certain arts of the producer. Responsibilities of researchers in animal husbandry include application of concepts and techniques of basic sciences, reducing, where possible, the arts of the producer to an objective basis, and testing some of the prevalent, untested concepts and lores of the field. Research undertaken by animal husbandmen is initiated with the intent of securing information which may be of immediate or eventual economic importance.

esearch Results in Record of Performance Programs

Recommended record of performnce programs for beef producers ave been established during the past ear. These programs have resulted irectly from 8 years of research. asic research was conducted at Colge Park in order to lay a foundaion for an economic evaluation of he advisability of doing performance esting. At the same time, research as also done on Maryland farms. he information and experience ained from this phase of the work elped to find solutions to problems hich arose when the programs were laced in operation under practical onditions.

Five different plans of procedure ave resulted from the research. hese plans progress in completeness from a relatively simple but useful plan to one which includes a complete set of records on the herd. The large amount of latitude in choice of suggested programs is intended to encourage each producer to establish the plan of procedure best fitted to the needs of his own farm.

Experimental results and observations on farms indicate a real need for, and the value of, testing the performance of beef cattle. In order to make testing more widely available to producers, Agriculture Experiment Station personnel have cooperated with Extension Service personnel in providing plans, suitable forms, and other information pertaining to the testing of performance.

(Projects C-14, C-14-a, C-14-b)

ew Scoring System Appears to be Practical

A practical yet informative system r the scoring of calves and other attle in a herd is, at the present time, part of a practical record of performance system for the producer of beef cattle. The data secured from the use of the new scoring system mentioned in last year's report have been analyzed. (The new scoring system, is based on the evaluation of 55 body parts. The system permits the use of scores under and over 100 percent in order to allow a producer to note not only the parts of the body which do not meet his standard of perfection; but also, the nature of the deficiency in a characteristic.)

Means, standard deviations, and coefficients of variation of both actual scores and deviations of the scorers from 100 percent have been calculated from the scores recorded by each of 4 scorers. Two groups of animals were scored: bull calves and mature females. As with the simpler scoring system previously used, a reasonably large difference among the scores of different scorers was found, especially for certain items of conformation. It was interesting to note that little if any variation among the animals was noted by any of the scorers for 2 of the items scored. This indicated that either there was no variation among the animals, or the variations were so slight that recording them from visable observation was very difficult or impossible.

Experiences indicated that, with the exception of the deletion of a few items, the new scoring system is practical for use by the producer who may wish to have detailed evaluations of the animals within his herd. The new scoring system involves more time for the scoring of an individual animal (8 minutes) than did the scoring system formerly used (2 minutes) but the additional time used appears to be spent gainfully.

(Project C-14-b

Group-Fed Calves Gain More Rapidly, But Less Efficiently

Group-fed calves gained 0.12 pound per head per day more than the individually fed calves, but consumed 41 pounds more feed per hundred pounds of gain plus maintenance than those fed individually.

This was the second year of the gain-test trial of group vs. individual feeding, with 20 Aberdeen-Angus and 26 Herefords from the University of Maryland's herds on test. They were weaned and started on a gain-test trial on October 9, 1956. Calves were allotted for group or individual feeding by sire, breed, and sex. They averaged approximately 8 months of age and 457 pounds in weight at the start of the trial.

The results of the first and second year's work were similar in that calves fed in groups gained more rapidly, on the average, than those fed individually. This was true both years in each of the 4 sub-groups (Aberdeen Angus steers, Aberdeen Angus heifers, Hereford steers, and Hereford heifers). The 1956 group fed calves gained an average of 1.8 pounds per head daily and the individually fed calves gained an average of 1.71 pounds per head daily during the 224 days they were on trial. Gains of the 1955 calves were 1.71 and 1.5 pounds per head daily for group-and individually-fed calves respectively.

Detail scores and measurements of the calves were secured at the beginning and end of the feeding trial. These scores and measurements will be studied in relation to rate and economy of gain. There were approximately 45 calves started on gain-test trial on October 8, 1957.

(Project C-14-

Rumen contents of sheep on nutrition experiments are sampled by means of a stomach tube and vacuum pump.

Rumen Volatile Fatty Acid Production Studied in Lambs

Volatile fatty acids (VFA) constitute the major source of energy for ruminant animals. These acids are produced in the rumen as a result of bacterial action upon fibers, other carbohydrates and proteins present in the feeds. Cattle or sheep do not secrete enzymes capable of digesting cellulose, the chief constituent of fiber in roughages, and their ability to utilize roughages is dependent upon bacteria in the rumen.

It is important that processes involved in production of VFA and the factors that control them be understood. Knowledge gained from basic studies on rumen function may eventually be applied in feeding ruminants to increase efficiency of production of meat, milk and wool.

Current research involves studies of the relationship between VFA present in the rumen and VFA produced by bacteria in *in vitro* studies, and the effects of diet and feed additives upon VFA production by rumen bacteria.

Studies have been made on the effects of aureomycin on VFA levels in the rumen and on *in vitro* VFA production from uniformly labelled radioactive glucose by washed cell suspensions (WCS) of bacteria prepared from the rumen contents of fattening lambs. Results to date indicate that aureomycin fed at levels of 7, 12 or 24 mg. per lamb per day does not affect the concentrations or proportions of VFA in the rumen fluid. The antibiotic does not alter the pattern of dissimilation of glucose by rumen bacteria in the WCS.

Suckling lambs fed aureomycin by capsule gained slightly faster than control lambs from birth to 90 days of age. Hampshire and Southdown lambs receiving 10-20 mg. of aureomycin per lamb per day gained .68 and .53 lbs. per day while control lambs of the same breeds averaged .65 and .48 lbs. per day, respectively. Further studies will be conducted to determine the effect, if any, of continuous antibiotic feeding begun early in life upon VFA production in the rumen.

While work on VFA production did not show any differences due to aureomycin feeding, the results may be of considerable value in studies on rumen nutrition and physiology. These studies in lambs confirmed certain observations made earlier in dairy cows. There was a positive correlation between quantities of VFA recovered from glucose dissimilations and amounts of radio activity recovered, indicating that the WCS technique does give a good measure of production of VFA from added glucose. There was a tendency for amounts and proportion of VFA in the rumen and for the VFA produced during glucose dissimilations to stabilize after animals had been on the same diet for several weeks.

It has been demonstrated in cows that changing the diet from normal roughage-concentrate rations to low roughage rations made up primarily of cooked carbohydrates will change concentrations and distribution of the VFA, but variations observed in VFA ratios in rumen fluid do not necessarily coincide with variations in ratios of VFA produced by WCS.

Variations between animals and in the same animal make it difficult to evaluate the WCS technique as a method of studying rumen bacterial action. It would appear, however, that there are real differences in VFA molar percent ratios between rumen fluid and WCS end products in samples taken from the same animals at the same time; i. e., rumen fluid VFA is not necessarily predictive of VFA production in the WCS and *vice versa.* This can be interpreted to mean that levels of VFA in rumen fluid are not always indicative of amounts or proportions of various acids produced from feedstuffs by bacterial action in the rumen, but rather they represent a part of the rumen environment that is controlled by both the ruminant animal and rumen population.

Studies now under way will continue to investigate factors that control VFA production in the rumen.

(Project C-21)

Factors Affecting Bloat Being Studied

Studies on the relationship of physical condition of rumen contents to bloating and on the role of rumen bacteria in bloat are being continued. Attempts to cause experimental bloat by increasing viscosity of rumen fluid in sheep have not yet been successful. Gum Guar, a polysaccharide that increases viscosity in many aqueous solutions, did not increase viscosity in the rumen and it was subsequently determined that rumen microflora possess an enzyme capable of hydrolyzing the polysaccharide.

Investigations now under way will involve administration of several viscosity-increasing agents. If viscosity of the rumen fluid can be increased, the effect of viscosity *per se* on the rumen can be determined. Progress in studies on rumen factors in the bloat syndrone would be enhanced if it were possible to produce bloat consistently in experimental animals.

Studies are also being conducted to determine the mode of action of procaine penicillin which has been reported to reduce bloat in cattle grazing on legume pastures. Work with a limited number of sheep indicates that ewes which were bloating on alfalfa pasture before oral administration of penicillin will not bloat when 10-20 mg. of penicillin are given by capsule.

Preliminary results of studies on gas production and ingesta volume increase (IVI) in rumen samples taken from animals grazing on alfalfa indicate that there is considerable variation between animals in rate of gas production and IVI, irrespective of whether or not animals are bloating or are receiving penicillin.

Not enough information has been obtained to establish any relationships between gas production and IVI when animals bloat or are fed penicillin.

Radioisotopes are being employed in studies on gas production and VFA production by rumen microorganisms in bloating and non-bloating animals on similar rations.

(Project GC-45)

Intravenous and oral administration of penicillin are being studied in experiments on bloat.

Antibiotics and B_{12} Permit Lower Protein Levels

Research evidence suggests that addition of vitamin B_{12} and antibiotics to growing-fattening rations of swine permits a reduction in protein content of those rations. Logic suggests that similar additions to breeding, gestation and lactation rations may also permit reductions during these periods. Since feed accounts for 75 to 90 percent of the total costs of swine production, and since the protein supplement proportionately is the most expensive component of the ration, determination of minimal allowances of protein for optimal performance is essential to economical swine production.

Investigations concerning minimal protein allowances are divided into 2 phases (under separate projects). The first deals with rations used during breeding, gestation and lactation periods, while the second involves rations used during the growing-fattening period.

Phase one: Studies were initiated with the spring farrow of 1957 and involved rations containing 15 percent and 10 percent crude protein during the breeding, gestation and lactation periods. Although the number of gilts and sows that completed the test period was small (13 head), certain observations were made. There was no evidence to indicate that the 10 percent crude protein level fed during the breeding season affected adversely the number of females that conceived, or the number of matings required per conception. The same level of crude protein fed throughout the gestation period did not appear to reduce the total number of pigs born or born alive per litter, average birth weight, or vigor at birth.

Feeding 10 percent crude protein level throughout lactation did not seem to affect livability of pigs. However, at weaning (8 weeks of age) pigs from sows fed the lower protein level were less uniform in size, considerably lighter in weight, and lacked bloom compared to those from sows fed at the 15 percent crude protein level.

Additional studies relative to this first phase are being conducted to evaluate more adequately effects of protein level in rations during breeding, gestation and lactation periods. *(Project C-23)*

Phase two: Since barley usually is a more economical feed for swine than corn during the early fall season and occasionally for a material portion of the year in Maryland, these investigations were conducted using mixed rations containing corn or barley as the only grain, and soybean oilmeal, meat and bone scraps and dehydrated alfalfa meal as principle sources of protein. Four groups of 10 pigs (allotted at random) were drylot fed the rations shown below:

Group	*Grain*	*Crude Protein* 46 *to* 125 *lbs.* percent	*Crude Protein* 125 *to* 200 *lbs.* percent
1	corn	18	15
2	corn	14	11
3	barley	18	15
4	barley	14	11

Group 1 gained 7 percent faster on a similar amount of feed per hundred-weight of gain than group 2. In the barley phase, group 3 gained 7 percent faster on 5 percent less feed per hundred weight of gain than group 4. The corn fed groups gained an average of 15 percent faster on 18 percent less feed per hundred-weight of gain than did the groups receiving barley.

The results of phase two suggest that additional investigations should be conducted before minimal protein levels for optimal rate and efficiency of gain can be established for growing and fattening pigs fed in drylot.

(Project C-26)

New Worming Compound Tests Continue

Tests comparing the effectiveness of new compounds for control of internal parasites in swine with the standard treatment of sodium fluoride were continued during 1956. Large intestinal roundworms (ascarids) were the only parasites found to be present in the 3 studies conducted.

Sodium fluoride and the insoluble form of piperazine CS_2 proved to be more effective ascaricides than cadmium anthranilate or the soluble form of piperazine CS_2. This conclusion was based on the number of parasites expelled following treatment, reduction in number of parasite eggs per gram of feces following treatment, and number of parasites found in intestinal tracts of swine slaughtered 14 days after treatment.

Observations on palatability of the various products studied suggested that sodium fluoride and the soluble piperazine CS_2 were the only anthelmintics distasteful to swine. However, soluble piperazine CS_2 was the only product which proved so distasteful as to prevent adequate intakes for effective internal parasite removal.

No evidence of toxicity was observed with the new anthelmintics whereas vomiting, depressed growth rate, and even death have resulted when extreme care was not exercised in administration of sodium fluoride.

Pigs that were healthy and in a relatively parasite-free state at 8 weeks of age, through the use of recommended sanitation practices, appeared to have considerable resistance to parasitic infestation thereafter.

Future studies of anthelmintics shall include other compounds of the piperazine and cadmium groups as well as the antibiotic Hygromycin.

(Project C-24)

Try Copper vs. Antibiotic for Growing-Fattening Swine

Studies in England suggest that growing-fattening swine on hand-fed rations containing copper, as copper sulfate, may experience a stimulation in growth rate similar in magnitude to that experienced when antibiotics are fed. Since copper sulfate is inexpensive and readily available, exploratory studies to investigate its usefulness in self-feeding were initiated in the fall of 1956.

Five lots of 10 pigs each were fed from an average initial weight of 50 pounds to an average final weight of 200 pounds. The levels of copper investigated were 50, 100 and 150 parts per million (¼, ½ and ¾ pound of copper sulfate per ton of feed) added to a corn, soybean oilmeal and meat and bone scraps type diet. An antibiotic, Aureomycin (chlortetracycline), was fed at the rate of 10 grams per ton of feed to the fourth lot of pigs. The fifth, a control lot, received no additions of copper or antibiotic.

Average pounds of daily gain and

pounds of feed required per hundred-weight of gain for each treatment group, respectively, were: control, 1.19 and 472; copper, 50 p.p.m., 1.21 and 408; 100 p.p.m., 1.29 and 425; 150 p.p.m., 1.22 and 431; and aureomycin, 1.25 and 426. One hundred parts per million of copper increased the rate of gain 8 percent and feed efficiency 10 percent.

The favorable effect of all treatments on rate of gain diminished as weight of pigs increased and was limited after pigs reached 125 pounds in live weight. Effect on efficiency of gain of all treatments relative to the control group remained distinctly favorable at all weights throughout the study.

Since this study was exploratory in nature, additional investigations are contemplated.

(Project C-27)

Pelleted Swine Rations Tested

The value of pelleting swine rations is of interest to Maryland producers since rations fed in the form of a meal contribute to a certain amount of unavoidable waste. Also, pelleting usually is believed to contribute to greater consumption particularly when relatively unpalatable feeds such as barley are fed.

The first phase of an exploratory investigation was initiated to evaluate the effects of pelleting a complete, mixed ration formulated with barley as the only grain for weanling pigs fed from approximately 46 pounds to 125 pounds in live weight. The group fed the ration containing barley in pelleted form gained 16 percent faster on 27 percent less feed per unit of gain than a similar group fed a similar ration in the form of a meal, and 7 percent faster on 13 percent less feed than a second similar group of pigs fed the same calculated protein level in a mixed ration containing corn. The group fed the pelleted barley-containing ration consumed 14 percent less feed per head per day than the group fed a similar ration as a meal, and 10 percent less than the group fed the mixed ration containing corn.

The second phase of the trial was designed to evaluate the effects of pelleting a complete, mixed ration containing corn as the only grain for hogs from 125 pounds to 200 pounds in live weight. During this phase of the study, the group fed the pelleted ration containing corn gained 2 percent faster than a similar group fed a similar ration in the meal form. However, (1) feed consumption per head per day was increased 7 percent when the pelleted ration was fed, and (2) the feed requirement per hundred weight of gain was increased 5 percent.

Additional investigations to study further the value of pelleting mixed rations containing barley as the only grain are in progress because results of this preliminary work appear to be of interest and of potential value for producers.

(Project C-28)

Compare Free-Choice vs. Complete Mixed Rations

Discovery of the value of vitamin B_{12} and antibiotics in rations of growing-fattening swine has led to a material shift from free-choice feeding to feeding complete, mixed rations. This shift has added such costs as hauling, grinding and mixing to costs of production of many producers, and has caused them to question the need for complete, mixed rations in economical swine production.

The investigation was conducted to compare the free-choice feeding of two protein supplements and shelled corn against the complete, mixed rations usually fed at this station. The two supplements each contained soybean oilmeal and meat and bone scraps but only one contained dehydrated alfalfa meal. All groups were fed in drylot from an initial weight of approximately 60 pounds to a final weight of approximately 200 pounds.

For the total 103 day feeding period, method of feeding in drylot had little, if any, effect on rate of gain. However, free-choice feeding did appear to contribute to a slight reduction in the feed requirement and in the consumption of supplement per hundred-weight of gain. These reductions occurred principally during the period from 125 pounds to 200 pounds in live weight. During this period, the group free-choice fed the protein supplement containing alfalfa meal consumed 35 percent less supplement and 17 percent less total feed per cwt. of gain than the group fed the complete, mixed ration. The reductions were 32 and 15 percent, respectively, for the group fed the supplement without alfalfa meal when it was compared with the group fed the complete, mixed ration.

Free-choice feeding of shelled corn and either of the 2 supplements investigated resulted in a reduction in feed costs that exceeded $1.00 per hundred weight of gain. The actual feed costs per cwt. of gain were as follows: complete mixed ration, $13.06; shelled corn and the supplement containing alfalfa meal, $11.74; shelled corn and the supplement without alfalfa meal, $11.57.

Additional studies on the formulation of protein supplements are contemplated in an attempt to reduce further the costs of feeds used in the production of growing-fattening swine.

(Project C-29)

BOTANY

Research in the Department of Botany includes projects designed to yield information useful in solving immediate problems in the field as well as projects of a more basic nature designed to yield information of the kind upon which all progress in science ultimately rests.

The scope of the research in progress in the Department of Botany is indicated by the brief reports of projects that follow.

Antibiotics Show Promise in the Control of Plant Diseases

The effectiveness of various antibiotics in treatment of diseases of man and domestic animals has stimulated interest in the use of similar compounds to control diseases of plants. An antifungal produced in the laboratory in cultures of an organism isolated from Maryland soil shows promise of controlling some plant diseases in greenhouse tests. Work is underway in the laboratory to develop methods of producing, isolating and characterizing this antifungal substance.

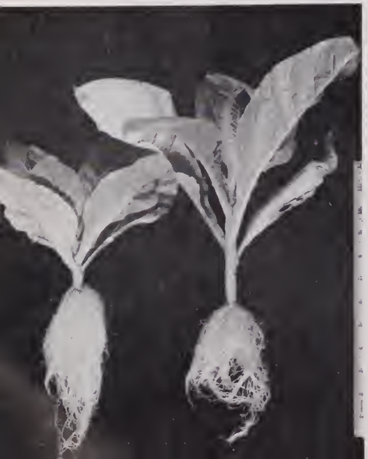
Effectiveness of a number of commercially available antibiotics in preventing growth of several bacterial plant pathogens in culture in the laboratory has been studied. Strains of Pseudomonas soloracearum which could withstand concentrations of some of the antibiotics about 500 times as great as the concentration required to prevent growth of the predominant wild strains of this bacterium were isolated. Existence of such strains might limit the usefulness of antibiotics in control of plant disease.

(Project J-92)

Nematode Damage Widespread

Through a survey of over 1200 farms throughout Maryland, it has been found that all fields are infested with at least one, and usually several, species of plant parasitic nematodes. There are probably several hundred species present, each attacking a variety of plants. Among the most important are the meadow nematodes, *Pratylechus;* spiral nematodes, *Rotylechus,* and *Helicotylenchus;* dagger nematodes, *Xiphinema;* pin nematodes, *Paratylenchus,* cyst nematodes, *Heterodera;* and the stylet nematodes, *Tylenchorhynchus.*

Effect of *Paratylenchus projectus,* the pin nematode, on tobacco. The plant on the left was inoculated with 10,000 nematodes; plant on the right is nematode-free.



Pathogenicity studies to determine the disease-causing abilities of some of these nematodes have been conducted. *Trichodorus christiei,* one of the stubby-root nematodes, causes severe stunting to tomatoes. In greenhouse tests, this nematode has been found to infect over 100 crops and crop varieties including those commonly grown in Maryland. It does not attack asparagus, jimson weed, Crotalaria, and poinsettia. This extensive host range makes control by rotation impractical.

Another nematode capable of causing severe injury to crops is *Paratylenchus projectus,* a pin nematode. This nematode also has a wide host range but does not feed on the Chantenay variety of carrot, Palmetto and Marketer varieties of cucumber, and the California Wonder variety of pepper. Thus, control by rotation may be useful in some cases. Small populations of this nematode actually stimulate root growth, but damage eventually results when populations increase.

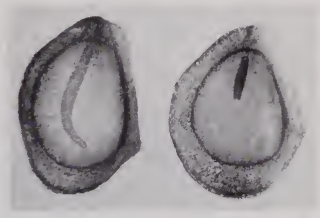
Azalea decline, a condition characterized by stunted growth and chlorosis followed by death of branches has been associated with large populations of *Tylenchorhynchus claytoni*. A detailed study of this problem has been initiated to establish control methods.

(Project J-96)

Study Biological Effects of X-Rays on Plants

The increasing use of ionizing radiation in modern society necessitates studies of the accompanying biological effects. X-rays, the most frequently employed source of ionizing radiation, are useful in plant breeding studies. However, deleterious biological effects may result following X-ray treatment. Lily seeds with embryos of sub-normal size were observed following X-irradiation of the pollen. A study of the chromosomes of plants arising from these atypical seeds disclosed that sub-normal embryo development was correlated with losses of portions of the hereditary material.

A single-spear shear press has been developed in order to facilitate anatomical studies in relation to quality in asparagus. The evaluations of "toughness" are obtained by the specially designed shear press without destroying the tissues for microscopical examination. A sub-epidermal ring of tissue, believed to be the major factor in "toughness," has been found to be composed of living cells rather than of fibre composed of dead cells. Respiration studies are being initiated to determine if physiological changes are associated with thickening of the tissues in the sub-epidermal ring.



Left: Regal lily seed with full sized embryo from a cross with normal pollen. *Right:* Regal lily seed with a small embryo from a cross employing X-rayed pollen.

(Project F-16)

Investigate Use of Twin Seedlings for Forest Improvement

A forest improvement program using conventional breeding techniques requires a great amount of time. However, a study of the literature shows that twin seedlings occur in several forest species. If haploids were present among these twins, true-breeding lines could be obtained in a relatively short time. Preliminary work shows that twins are indeed present in 4 species of softwood and 1 oak species. It has also been shown that seeds from the same species (but different stands) vary in the frequencies of twins produced. The chromosome numbers of the twin seedlings isolated are being determined in order to ascertain if haploids are present.

(Project F-17)

Development of Disease Resistance Difficult

In a number of instances the development of resistance in commercial tobacco is dependent upon obtaining resistant factors from species other than *Nicotianae tabacam*. Two species, one resistant to anthracnose and the other apparently immune to aphids have been crossed with Maryland tobacco. Seed was obtained from the crosses and most of the seed germinated. However, in the cross for anthracnose resistance, all germinated seed grew to maturity but were male-sterile. In the cross for aphid resistance, although the seed germinated, some lethal factor killed the plants before they could flower. Crosses were made each year for 3 years in an attempt to obtain a plant resistant to aphid. One such plant was obtained which grew to maturity and produced hundreds of flowers, but all were sterile.

The F_1 progeny of the interspecific crosses showed resistance to anthracnose in one cross, and resistance to aphids in the other cross. Cuttings were made from the survivors of the crosses and then treated with 0.4 percent colchicine for 24 hours. The entire cutting was dipped in the solution. One of the treated anthracnose-resistant cuttings was crossed with Maryland tobacco as the female. The cutting was also used as the female plant using pollen from the Maryland plant. Also, flowers from the treated cutting were selfed. Seed was obtained in each case. Six of the treated aphid-resistant cuttings produced seed when pollen from a Maryland tobacco was used. Only one of the plants could be selfed and backcrossed with Maryland tobacco. Thus, after a number of years and attempts, it is now possible to continue the work of developing resistance to anthracnose and aphids.

Work is continuing on the development of Maryland tobacco resistant to black shank, mosaic, wildfire, black root rot and Granville wilt.

(Project J-95)

Wilt-Resistant Tomatoes Susceptible after Nematode Infection

The tomato variety Chesapeake is highly resistant to Fusarium wilt. It is not normally found infected under field conditions. When root-knot nematodes *Meloidogyne hapla* and *M. incognita acrita* were used in combination with the fungus, *Fusarium oxysporum* f. *lycopersici,* plants became wilted and exhibited typical symptoms of Fusarium wilt. The variety Rutgers is somewhat wilt-resistant but became highly susceptible under these conditions and wilted in a shorter time.

Since nematodes feed by punching holes in roots and sucking out plant juices, it was thought that this wounding might account for loss of resistance. Tests were conducted where roots were artificially wounded periodically, but no increase in susceptibility was noted. It was concluded that the loss of resistance is due to a reaction of the host or some other non-mechanical means. Further investigations into this problem have been initiated.

A material toxic to nematodes has been isolated from the roots of asparagus. This material may be the reason why asparagus is resistant to many nematodes.

(Project J-97, NE-34)

Light Promotes Recovery of Boron-Induced Inhibition of Respiration

High concentrations of boron (e.g., 500 ppm) depress the respiration of carrot discs but, after several hours, the inhibition is largely overcome. Restoration of the "normal" rate occurs sooner in discs in light than in those kept in darkness. It was also observed that untreated discs respire more rapidly in light than in darkness and that the rates of respiration could be reversed by darkening discs that had been in the light and by giving light to those discs previously in darkness. A working hypothesis of the mode of action of light on respiration is currently being tested.

Working with known, pure solutions of borax and various sugars, an attempt has been made to isolate sugar-boron complexes prior to an examination of plant tissues for such compounds. Paper electrophoresis, rather than paper chromatography, appears to offer the best hope for isolating such compounds. The existence and nature of such compounds is now largely a matter of speculation.

(Project K-8-c)

Electron micrograph of hydrangea ringspot fungus.

Seek to Characterize Hydrangea Ringspot Fungus

In cooperation with the Live Stock Sanitary Service, Hydrangea ringspot virus was purified from hydrangea plants and certain of its properties determined. The characterization of this virus will aid in establishing the relationship of this virus to other viruses affecting economic crops.

One of the limiting factors in the progress of strawberry virus research is the difficulty of studying these viruses in strawberry plants. New hosts are presently being sought which will facilitate the study and control of these diseases.

(Project J-98)

Tests Show 7 Chemicals Effective against Black Shank

Numerous tests have been made in the greenhouse and field to control soil borne disease organisms. Over 50 chemicals with known fungicidal and bactericidal properties have been tested against soil borne organisms that cause black shank and black root rot of tobacco, damping off of tobacco, and red stele of strawberry.

Seven chemicals have been found which give definite control of black shank of tobacco when drenched on the soil. Four of the chemicals (which are salts of one compound) were fungicidal at 300-600 parts per million of soil weight and 3 of the chemicals were fungistatic from 100-400 ppm of soil weight. As soon as the latter 3 chemicals were washed out of the soil the tobacco died with the disease.

Attempts have been made to control the black root rot complex of strawberry with soil fumigants and fungicides. Results of field tests have been inconclusive. The Fusarium wilt-nematode complex of tobacco has been controlled by using soil fumigants as D-D and ethylene dibromide.

(Project J-93)

Study Haploids among Pepper Twins and Triplets

Haploids, having one-half the usual number of hereditary units, occur among twin seedlings of pepper. The haploids thus obtained have been treated with colchicine to produce lines free from hereditary variability. One of the lines derived in this manner produced a strikingly high frequency of haploids among the twin and triplet seedlings. Approximately 3 percent of the seeds produced twin seedlings with one haploid and one normal member. The hereditary constitution of this line thus greatly increases the frequency of twin seedlings with haploid members. Crosses have been made, utilizing this line as the female parent, in order to determine if the male parent has an effect on the frequency of haploids. The seedling population is being analyzed to determine if haploids are limited to twin seedlings or if they also occur among the individual seedlings.

(Project F-15-b)

Research Leads to Additional Information about Scurf

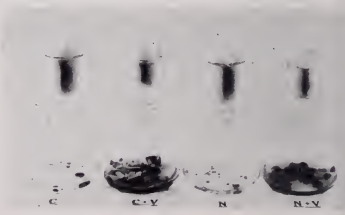
None of 27 varieties and 13 seedling sweet potatoes were immune, or even highly resistant, to infection from any of 13 isolates of the scurf fungus. However, there were differences in the severity of infection on certain varieties and seedlings.

The host range of the scurf fungus was extended by inoculations in the greenhouse to include eight additional species of *Ipomoea* and one hybrid.

In culture, the scurf fungus grew well on plant decoction media, but the pathogen failed to grow on synthetic media unless it was supplemented with the vitamins biotin and thiamine.

Experiments for control of scurf in the field were continued. Several fungicides, including thiram, ferbam, captan, and Puratized Agricultural

Scurf fungus in synthetic medium (Czapek's). C-casein hydrolysate plus vitamins; N-Czapek's medium with sodium nitrate as nitrogen source; N + V-Czapek's medium plus vitamins.



Spray, when used as instantaneous dips on bedding stock and sprouts or sprouts alone, gave control of scurf in field plots. Experimental results emphasize the importance of dipping the underground parts of the rooted sprouts in an effective fungicide prior to planting for satisfactory control of scurf.

(Project J-86-a)

Different Tomato Varieties May Need Different Timing of Sprays

A number of fungicides were tested in field plots for control of foliage diseases of tomatoes and cucumbers. None of the experimental fungicides or combinations of fungicides appeared to be superior to the dithiocarbamates generally recommended for control of tomato diseases.

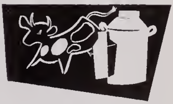
There is evidence that the different varieties of tomatoes may require slightly different timing of sprays. For example, the spray program may need to start earlier on the paste type than on the globe types.

Experiments made in cooperation with the Department of Horticulture indicate that spray programs can be developed that will control downy mildew of cucumbers even when they are under overhead irrigation.

Studies in the laboratory were designed to further clarify the mode of action of certain fungicides. Cysteine and similar compounds may destroy the fungitoxicity of captan in the laboratory but it is apparently with compounds of this kind that captan reacts inside the cells to bring about its toxic effects on fungi. Traces of heavy metals in fungus cells appear to be essential for most effective toxicity of sodium dimethyldithiocarbamate. Zinc seems to be the heavy metal principally involved.

(Project J-91)

DAIRY



The dairy research program includes studies on more efficient milk production as well as processing of milk and milk products.

Development of a method for studying the activity of the rumen, after removal from the cow, has been especially helpful. Studies on rumen bacteria have continued to provide valuable information.

New methods have been established for studying the flavor properties of milk products. These studies, along with work directly applied to improving the characteristics of present products, have an important effect on the quality of dairy products available to the public.

Objective Test of Dry Milk Quality Developed

A simple colorimetric test for hydroxymethylfurfural (HMF) has been developed. HMF is a key intermediate in the Maillard-type browning deterioration, which is one of the serious problems in keeping dry milks. The new test will be useful as a quality control procedure in evaluating dry milk and predicting the flavor stability of dry milk during storage.

(Projects G-35, G-48)

Factors Affecting Flavor Quality of Instant Dry Milk Studied

Instant non-fat dry milk has become an important retail dairy commodity within the past several years. Study of this product has indicated that the manufacturing conditions used during the instantizing process markedly affect the flavor quality and flavor stability of the finished product.

Instant milk is manufactured by wetting conventional spray dried milk with wet steam to 10-20 percent moisture. The wet mass is then dried in hot air and the resulting product is composed of relatively large particles of low density, which disperse readily in water.

Comparative study of instant dry milks and regular dry milks, from which they were prepared, have definitely indicated that the instantizing processes intensify the browning type reaction. These reactions lead to the development of flavor compounds which detract from quality.

It would appear that improvement can be made in the flavor quality of instant dry milks by moving in the direction of using less strenuous conditions of steam and hot air treatment during instantizing.

(Project G-48)

Work Continued on Colorimetric Fat Test

Work on standardizing the methodology of the colorimetric test for fat in milk has been continued. This test is based on the hydroxamic acid reaction. Intensity of red color developed in the sample is proportional to the fat content of the milk. The new test is as accurate as the Babcock Test in its present state of development.

(Project G-35)

Body and Texture Qualities of Sherbet Improved

Substantial improvement in the body and texture of sherbets was accomplished by using various combinations of sweetening agents. Dextrose, sucrose and corn syrup solids (C.S.S.) were used. The C. S. S. preparation had dextrose equivalents (D. E.) ranging from 30 to 54.

Preliminary studies with a judging panel suggested that 2 types of sherbets are desirable. One group preferred sherbets exhibiting a heavy "chewy" type body, while the other group preferred the weak body, fast melting sherbet.

A smooth type body can be obtained by use of 22 percent of a 42 D. E. corn syrup and 13 percent sucrose. A sherbet with the weak body, fast melting characteristic is prepared by using 22 percent sucrose and 8.5 percent dextrose. Various combinations of sweetening agents will give sherbets with a freezing point comparable to that of ice cream.

The study also revealed that high acidity sherbets are preferred. Acidities, expressed as citric acid, were acceptable at levels of .55 percent in sherbets with total solids ranging from 30 to 40 percent.

(Project G-42)

Excessive Agitation Speeds Rancidity in Bulk Milk Tanks

Previous reports have pointed up the possibilities of storing milk for several days in a farm bulk tank when satisfactory conditions are maintained.

Studies were continued to observe the effects of repeated agitation on the initiation of a rancid flavor in milk. Lipolysis (rancidity) resulted in the following instances: (1) agitation for very short periods following freezing and thawing of milk in the tank; (2) agitation for 1 hour in a partially filled tank (with the agitator covered by 1 to 2 inches of milk); (3) agitation for 3 hours in full tank. Under normal operating procedure, no rancid flavor developed in the experimental trials.

The season of year or stage of lactation had no effect on the quality of milk held for extended periods.

The experiment definitely reaffirmed the concept that there is no substitute for continuously maintaining a high standard of quality throughout production and processing.

(Project G-44)

Develop New Information on Browning of Overheated Milk

Studies have been continued on the characterization and identification of the brown pigment formed in milk subjected to high heat treatment. The brown pigment has been isolated and the 2,4-dinitrophenylhydrazone derivatives have been formed.

The fractionation of these derivatives has received major consideration this past year. Carbonyl and dicarbonyl compounds have been isolated. However, the separation and purification of any compounds in these groups have not been achieved.

(Project G-40)

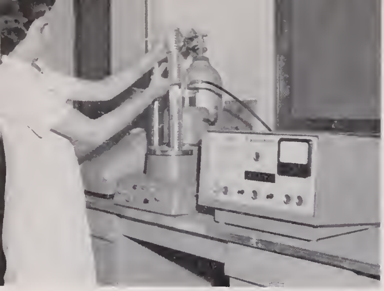
Test Unusual Nitrogenous Substances on Rumen Bacteria

It was shown that the number and kinds of rumen bacteria which can be grown outside of the rumen (in vitro) depends, in part, on the nature and amount of the nitrogen source.

A number of nitrogenous substances not studied previously (xanthine, uric acid and guanine hydrochloric acid) were completely degraded by rumen bacteria (washed cell suspensions) at a slow rate, as is the case with other insoluble ruminant feedstuffs, such as cellulose. The end-products formed were carbon dioxide, ammonia and acetic acid. Hydroxanthine was incompletely degraded and adenine was neither deaminated nor decarboxylated.

Substances (peptones, amino acid mixtures, purines and pyrimidines) which ordinarily enhance the growth of non-rumen bacteria are not good nitrogen sources for rumen bacteria, compared to rumen fluid.

(Project G-39)



How the cow uses feeds and converts them into milk is being established by labeling feed with radioisotopes and tracing it by means of the Geiger counters shown here.

Find New Substances for Oral Treatment of Ketosis

New substances for oral treatment of ketosis have been tested and found to be effective.

Aluminum lactate and various combinations of lactic acid and aluminum hydroxyde were found to be the most useful forms of lactic acid for the treatment of ketosis when 2 pounds were given orally the first day, followed by 1 pound per day for several days thereafter.

Others were tested, but found unsatisfactory. Sodium lactate was found to produce a marked increase in blood sugar when given orally, but was too laxative when administered in large amounts. Lactamide was not laxative, and did not increase blood sugar. Lactide was found to be highly palatable, and very effective in increasing blood sugar, but toxic to the animal. Buffered lactide was found to be less toxic. Sodium aluminum lactate was found to be relatively palatable, but rather ineffective for increasing blood sugar.

A relatively new and highly potent glucocorticoid, 9-alpha-fluorohydrocortisone, was reported in the 67th Annual Report to be 15 times more potent than cortisone for the treatment of ketosis. In the following year it was observed that several deaths in cattle resulted from its use. During the past year it was found that this substance could be used safely when the animal was not permitted access to sodium chloride or other sodium salts. While a concentrate ration containing one percent sodium chloride did not appear to be harmful when fed following the injection of 9-alpha-fluorohydrocortisone, it is considered that the latter substance would be even more effective if the feed did not contain added sodium chloride.

(Project G-37)

New Techniques Developed for Bloat Studies

By incubating rumen bacteria (washed cell suspensions) with various substances, a practical and accurate method for studying the gases produced in the rumen was formed.

Rumen bacteria were shown to produce methane from carbon dioxide and molecular hydrogen. An active hydrogenase was demonstrated and methane formation from soluble carbohydrate was shown to occur from starch within the bacteria, as well as from added carbohydrates.

Additional studies with a bloat-producing diet confirmed last year's report of a high degree of encapsulation of rumen bacteria from cattle fed this diet. New diets with a chemical composition similar to the bloat-producing diet resulted in some degree of bacterial encapsulation, but a low incidence of bloat. Thus, it remains to be determined whether the formation of a capsule around the rumen bacteria and the resulting slime production is a major cause of bloat.

(Project GC-45)

New Information on Causes of Variations in Milk Fat Tests

In the previous annual report (Bulletin A-87), it was noted that a ration containing a high percentage of bread depressed the milk fat test by 40 to 70 per cent. During the past year new rations were developed which had similar depressing effects upon milk fat tests. Rations containing a high content of cooked starch (bread, cooked rice, potato meal and molasses), when fed with limited amounts of hay, resulted in a decrease in the fat test of the milk of 50 percent or more.

The decrease in milk fat percent was found to be associated with a major change in the digestion of the feed by rumen bacteria. It was noted that the proportions of the various volatile fatty acids in the rumen were altered greatly by the low fat producing diet, and that these proportions were more closely related to the milk fat percent than the total acids in the rumen or the absolute concentration of any one volatile fatty acid in the rumen.

It was concluded that, when the concentrate is altered greatly by processing, such as by cooking, an adverse effect upon milk fat production may be induced, which is far greater than that which can be induced by feeding low levels of hay with more normal concentrates. Incubation of the bacteria (washed cell suspensions) with radioactive substances, such as glucose labelled with radioactive carbon, demonstrated that the metabolic activity of the rumen bacteria had been altered greatly by the ration, which in turn induced the production of low fat milk. Thus, the metabolic activity of rumen bacteria has a very significant, and perhaps the most important, influence on milk fat production. It is considered significant, also, that this activity can be altered by changes in the ration.

(Projects G-37, G-38)

Large chromotographic column being used for isolation and identification of volatile fatty acids found in the blood after being produced in the rumen.

Hormones Exert Controlling Influence on Fat Formation

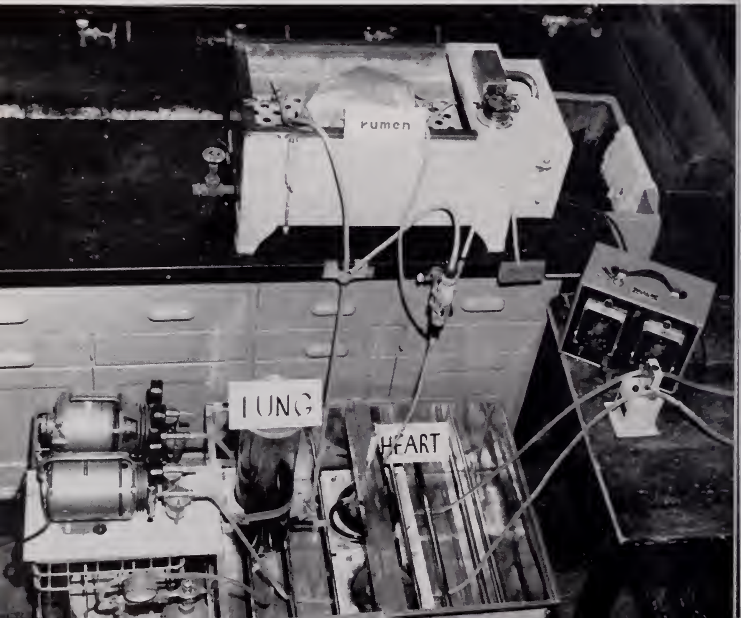
Growth hormone, which is the most potent hormone known for increasing milk production, was shown not only to increase milk fat production, but also to induce a change in the kind of fat produced. The degree of unsaturation of the milk fatty acids was increased markedly following administration of growth hormones. Adrenocorticortrophin, on the other hand, was shown to decrease milk fat production and also to decrease the unsaturation of the fatty acids of milk fat. This constitutes evidence that the kind of milk fat formed can be altered by changing the kind of fat in the blood which controls the amount of unsaturated fatty acids in the milk fat. The above mentioned hormones, therefore, may play an important role not only in the amount, but in the kind of milk fat produced.

(Project G-46, NE-30)

Radioisotopes and "Mechanical Cow" Help in Nutrition Research

Radioisotopes are being used in most of the research on dairy cattle and other ruminants being conducted by investigators in the Dairy Department, in cooperation with members of the Departments of Animal Husbandry and Bacteriology. These researchers have formed a radioisotope

"Mechanical cow" in which a living stomach (rumen) is used to determine how the cow converts feeds into milk.



team for the more effective use of radioisotopes in ruminant investigations.

Studies have been continued on the "mechanical cow," which is an apparatus consisting of an artificial heart and lung, used to pump blood through the excised udder of a cow. Previously, it was found that radioactive beta-hydroxybutyric acid (which originates from rumen bacterial activity) when added to this system, is converted into the short chain fatty acids of milk fat. This past year, it was found that this substance is also used for the formation of longer fatty acids, though to a much lesser extent.

The heart-lung apparatus is now being used for studies of the nutrition of the rumen of sheep, goats, and cows. It is used to pump blood through the excised rumina of these animals in order to determine what end-products are produced from feedstuffs by rumen microorganisms and in what form they are absorbed into the blood from the rumen. Radioisotopes are being used to trace the passage of these substances from the rumen into the blood. Using this new "mechanical-ruminant," it was found that a surprising amount of longer chain volatile fatty acids pass into the blood from the rumen, and that the amounts can be changed by changing the diet. These acids represent an appreciable amount of the total energy derived from the feed.

(Project G-43)

Test Concentrate-Forage Ratios for Milking Cows

Three combinations of concentrates and alfalfa hay, in which 80 percent, 40 percent, and 20 percent of the total net energy was supplied from concentrates, were fed. Experimental periods started 3 weeks prior to calving. Individual cows were fed the same ration throughout an entire lactation. Total intake was limited to 110 percent of the upper limit of Morrison's recommendations.

Preliminary results indicate that the efficiency of utilization of energy for milk production and body increase was the same for all combinations of forage and concentrates. Careful observations made on the incidence of mastitis and udder edema indicated no differences due to the feeding program.

(Project G-39)

Early-Cut Alfalfa Has Highest Feeding Value

Digestion and lactation studies have been continued on first cutting alfalfa hay harvested at one-tenth bud, full bud, and one-half bloom. Digestion studies are underway on the second, third and fourth harvests, taken at the one-half bloom stage from all plots. Preliminary results indicate a loss of about 7 percent and 14 percent, respectively, in the feeding value of alfalfa harvested at full-bud and full-bloom when compared to that harvested at one-tenth bud.

Two years' observations indicate the strength of the stand has not been harmed by the early cutting. There was a slight advantage in total yield for the season for the harvest at full-bud.

(Project G-47)

ENTOMOLOGY

Research work in the Department of Entomology is concerned with obtaining information which can be used by farmers for increasing production and improving quality. Most crops require insecticidal treatments. These must provide a margin of greater yield which will exceed the cost of the treatments. It is this margin for which entomologists are constantly striving.

Leafhopper Most Serious Potato Pest

Greatest increase of potato yields in 4 years of experiments on spraying potatoes have resulted from control of the potato leafhopper. In 2 of the years potato leafhopper was not abundant and there were no differences in yields of treated and unsprayed plots. During the other 2 years, leafhopper was abundant and the largest yields were obtained from plots where leafhopper control was effected. Mild infestations of hoppers appear to reduce the vigor of the plant, and when heavy infestations occur the plant may be killed before tubers are made.

Dilan emulsion has, in these experiments, been the most effective insecticide against the potato leafhopper. Good results have been obtained with 1 quart per acre in 25 to 150 gallons of water applied with fixed boom on air blast sprayer.

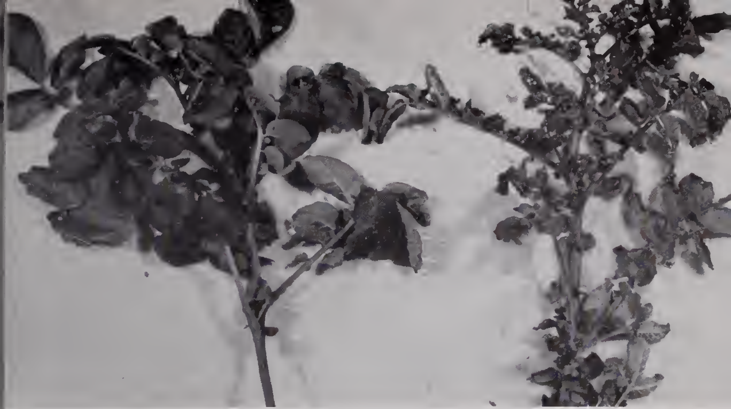
(Project H-46-d)

Pryethrum Sprays and Sanitation Best Control for Vinegar Gnat

Daily use of pyrethrum space sprays in packing plants, as well as on and around ripe tomatoes awaiting processing, has effectively reduced *Drosophila* populations. Reinfestation from skin damages and from the field may be prevented by spraying skin dumps with malathion and spraying loads of ripe fruit with pyrethrum before they leave the field. Treatment of empty baskets with malathion before returning to the field helps reduce the number of adults carried with the fruit to the canning plant, and retards oviposition on the transported fruit.

Extensive tests showed that insecticides sprayed on plants in the field did not satisfactorily reduce large populations. Encouraging results were obtained with a spray bait of dried yeast, sugar and malathion, but the high cost and necessity of frequent application of such a spray limits its practicability.

(Project H-29-k)



In small plot experiments and commercial potato plantings, Dilan has given excellent control of the potato leafhopper. Plant on left was protected with Dilan—plant on right was untreated.

European Corn Borer Populations Up in 1956

The increase in European corn borer population in 1956 is attributed in part to the reduction in parasitism by the *Lydella* fly and to delayed emergence of moths caused by prolonged cool spring weather. Delayed moth emergence and subsequent egg laying allows corn plants to reach sufficient size to support first generation larvae. When first generation larvae survive on early corn a large population usually follows in the second and third broods. These conditions occurred in 1956. From the standpoint of contamination of canning sweet corn there is usually little hazard from first brood larvae since nearly all of them have pupated and emerged before the early harvest. Late brood larvae infest both stalks and ears and are present at harvest time, causing a serious canning hazard.

The most practical control of the European corn borer, the corn earworm, and the fall armyworm is to plant the canning corn crop, if possible, so that it matures before insect populations build up in late season. Corn maturing during the first three weeks in August is the most desirable in Maryland. Canning sweet corn maturing in September nearly always requires insecticide treatment.

(Projects H-43, H-29-m)

"Slosser" Type Spray Boom Continues Superior Performance on Beans

Complete control of Mexican bean beetle and potato leafhopper was obtained in pilot commercial experiments on both snap and lima beans when recommended insecticides were applied with a "slosser" type spray boom. Elimination of these pests results in increased plant vigor and higher yields of better quality beans. With proper fertilization and sufficient irrigation, crops in excess of 5 tons per acre have been obtained.

Insecticides recommended by the Department of Entomology were used in these pilot tests. Dilan emulsion at 1 quart per acre is recommended for Mexican bean beetle, and potato leafhopper. If spider mites or aphids are present, malathion emulsion at 1 quart per acre is to be used instead of Dilan. Since a tolerance has not been granted for Dilan it should not be used on snap beans after blooming starts. DDT emulsion at 2 quarts per acre is recommended on both snap and lima beans in the fall for earworm control.

To get best results all insecticides should be applied in a protective spray schedule. Plant vigor should not be reduced by insect attack before treatments are applied. Usually 2 sprays are sufficient for snap beans and 3 to four sprays for Fordhook type lima beans. Small seeded limas require less spraying than the Fordhook variety for earworm control. Protective sprays are essential. On the Eastern Shore of Maryland they should begin the last week in August and be repeated every 10 days on lima beans. On late snap beans DDT should be applied when the first blossoms fall and should be repeated immediately after the first picking; earworms often feed on new foliage before attacking pods so that complete leaf coverage is necessary.

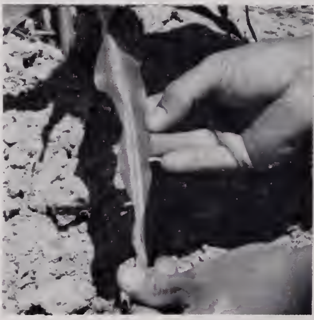
The annual loss of September maturing lima beans varies from 10 to 50 percent, increasing as the season advances. For control of earworm farmers should not wait until the worms begin to injure the pods, because by this time considerable loss has already been incurred. Young worms are difficult to see, particularly when they are feeding on foliage before moving to the fruit. Injury to pods is eliminated only when the young worms are killed while feeding on the foliage or blossom.

(Project H-29-l)

Granular Insecticides May Have Place in Control of Corn Insects

Granular DDT may be effective for controlling European corn borer and fall armyworm on late sweet corn. The granules carrying the insecticide appear to work down into the axils of the leaves as the plant grows and are particularly effective against fall armyworm.

Experimental application of granular DDT at the rate of 1.5 lbs. actual per acre (20 lbs. of 7.5 percent granular per acre) with ground equipment and 1.8 lbs. actual (25 lbs. of 7.5 percent material) by airplane were made on both early and late sweet corn. While results were not conclusive, they were encouraging particularly where applications



Typical streaking of corn leaf caused by Stewart's Disease or bacterial wilt. The disease organism is transmitted by the corn flea beetles.

Spreader for granular materials used to apply insecticide to the soil for control of soil insects, including corn flea beetles.

were made by airplane during the period when fall armyworm was present in late corn.

It was also found that tractor-drawn ground equipment was not satisfactory for treating late sweet corn, since available tractors are not high enough to pass over corn plants at the most effective time for applying treatments. Any equipment for applying granular insecticides to corn should be of a self-propelled high clearance type.

(Project H-29-m)

Malathion and Toxaphene Continue to Control Cabbage Looper

Of several insecticides tested against cabbage looper, imported cabbageworm, and cabbage aphid, malathion and toxaphene gave best results in a weekly protective spray schedule. Phosdrin also gave satisfactory control but provided no protective residue. Perthane emulsion at 1 quart per acre, trithion at 1 pint and diazinon at 1 pint per acre did not give satisfactory kill of cabbage loopers; however the latter two materials did give satisfactory control of cabbage aphids. Thimet applied at the rate of 1 lb. actual per acre was not effective against either aphids or worms. Thimet liquid at 8 oz. actual per acre applied to the plant appeared to be highly toxic to both aphids and loopers, but 2 applications did not protect plants during the growing and harvesting season.

Results of flavor evaluation of processed frozen samples showed slightly lower values for perthane and toxaphene plus sticker-spreader treated samples, but none of the treatments applied caused any appreciable flavor change.

Recommendations for commercial

treatment of cabbage, broccoli, and cauliflower were not changed for 1957. These recommendations are: weekly spray applications of 1 quart per acre each of malathion and toxaphene emulsions until heading starts. After heads begin to form malathion is to be continued weekly through the harvest period, with toxaphene added every third week. The purpose of toxaphene is to provide a protective residue if the malathion schedule is interrupted by bad weather. These insecticides are not extremely hazardous to spray operators and will not leave serious residues on heads or florets if applied immediately after cutting during the harvest period.

To secure satisfactory results plants must be thoroughly covered by the spray. There should be enough nozzles to give complete coverage of both top and bottom surfaces of leaves. Satisfactory control of insects on cole crops cannot be obtained with any known insecticide unless much attention is paid to the method of application.

(Project H-46-d)

HOME ECONOMICS

The utilization of beef and fish proteins by human beings has been studied in 3 metabolic experiments using college women as subjects. The diets eaten contained different quantities of protein, all of which were below, equal to, or slightly higher than the body's daily requirement. Since protein is not stored in appreciable quantities in the body, it was possible to study the contribution of each specific quantity to the body's need of protein. Differences in nitrogen retention were used as an indication of the extent of protein utilization of the body.

Study Utilization of Protein

All subjects adjusted to the basal diet in 9 to 12 days. When quantities of protein were increased by 5 to 10 grams, adjustment to the changed intake level was made in 6 days. There was no significant difference between the response of different subjects to each change in diet. When the diets contained smaller quantities of protein, the utilization by the different subjects was most similar.

In the 2 experiments when the subjects ate diets containing different quantities of protein, increasing from 10 to 50 grams, a definite pattern of response in retention was noted. The basal diet of 10 grams of protein contained no beef or haddock. As this diet was increased in protein by adding beef or haddock, the retention of nitrogen increased, but not in proportion to the increased amount of protein eaten. The amount of increased retention was conditioned by the length of time the subjects had eaten a lower amount of protein. During the first 3 days on a different intake level there was always a more marked retention than in the later days. The subjects reached an average peak of retention in these experiments when consuming 35 grams of protein. Nitrogen retention dropped slightly as the protein of the diet was increased to 40 and 50 grams. These responses indicated that the body adjusts to different levels of intake in an effort to keep an equilibrium between intake and output of nitrogen. If necessary it will sacrifice body tissue to do so. When more protein is eaten, this tissue is quickly restored by greater nitrogen retention, and equilibrium is again established.

In another 52-day experiment, when subjects ate a diet containing 42 grams of protein, of which 45 percent was beef or haddock, similar responses of nitrogen retention were noted. The subjects adjusted to similar retentions in 9 days. Thereafter, periodically, increased retentions occurred, and the peak of retention was reached after 5 weeks on experimentation, as in the other experiments. The average level of retention was higher throughout this experiment than in the other two. It appears that the protein of the diet is related to the amount of nitrogen retention, but other factors also influence this retention.

The average calories required for weight maintenance during each experiment increased from 600 to 1000 calories from beginning to end. The greatest need occurred at or shortly after the time of greatest nitrogen retention.

These experiments have shown that the human body uses the protein of beef and haddock equally well. A similar pattern, or rhythm of nitrogen retention has been shown to occur in all 3 metabolic experiments. This rhythmic pattern centers about the level of nitrogen retention to which the body has become accustomed.

The influence of the quantity of fat in the diet on nitrogen retention is now being studied.

(Project Y-1)

HORTICULTURE

The aim of horticultural research is to assist growers in more efficient production of fruit, vegetable and ornamental plants, and to develop new and better ways of processing fruits and vegetables. Besides the direct benefits to growers and processors, the general public enjoys many indirect benefits of this research. And through fundamental research on the more basic nature of this broad field, frontiers of knowledge are being opened up.

A well-balanced research program needs both applied and fundamental research.

This is what the Department of Horticulture is attempting to carry out.

Azaleas Dislike Fertilizer

Three years of field testing azaleas of the variety Hinodegiri has shown growth, structure and hardiness to be greatly affected by fertilizer applications. Although a winter mulch is essential for plant survival, a mulch around plants during the spring and late summer months did more harm than good. This indicates that the lower bark did not mature properly when protected by the mulch. As a result, winter injury was common to plants mulched during summer months.

Comparisons between soil-organic material combinations and soil-nonorganic material combinations show that the growing medium must contain 50 percent or more organic matter for best azalea development. Nitrogen is of value in plant development if applied moderately every third year. More frequent applications result in brittle wood that is susceptible to winter damage and mechanical injury. Flower development is also retarded by overdoses of nitrogen. Applications of phosphorous and potassium retard growth and flower development in soils containing a high percentage of inorganic matter. Root development is rapid and abundant in soil-peat mixtures if fertilizer is not used indiscriminantly.

(Project I-74-a)

Storage Conditions Influence Hydrangea Rest Period

In order to force hydrangeas into bloom quickly and with good quality they must have an adequate period of rest following the summer growing season. Plants of 3 varieties of hydrangea – Hamburg, Merveille and Strafford—were grown under natural day lengths and long day conditions (16 hours) beginning in mid-August to the time of storage. These plants were then placed in storages of 35, 45 or 55°F. for periods of 15, 30 or 45 days.

It was found that plants that had been stored for the longer periods began growth more rapidly when brought into the greenhouse and had longer stems and larger flowers than those stored for a short period. The coldest storage temperatures were the most effective in terminating the rest period when the length of storage was for only 15 days. With longer storage, the 45 and 55°F. storage were equally effective. Colder storage had a greater influence in increasing the stem length during the forcing than the warmer temperatures. Removing the foliage before storage had little influence on shortening the time for forcing and no effect on the size or quality of the flowering plant.

Increasing the day length in the weeks previous to storage actually had an adverse effect on the plant at the time of forcing since the flower size was smaller than plants receiving the natural day length.

(Project I-74-a)

Poinsettias Respond Best to 25-10-10 Fertilizer

Poinsettia stock (source or parent) plants require a relative high level of nitrogen and a moderate amount of phosphorous and potassium in order to produce the greatest amount of growth for the production of cuttings. Several fertilizer ratios were used in this study. It was found that a 2½-1-1 ratio gave the best growth and rooting response of cuttings. In these studies this fertilizer was a 25-10-10 completely soluble type. There was a slight varietal difference between the 2 varieties, Ruth Ecke and Barbara Ecke Supreme, used in the study.

The fertilizer study was continued with the young plants being grown for Christmas flowering. The use of the 25-10-10 was again found to be the most satisfactory in producing commercial quality plants. It produced plants with larger flowers, with longer stems and on those plants that were topped or pinched, more flowers per stem. The moderate levels of phosphorous and potassium were adequate for good growth. Under certain conditions a chlorosis of the lower leaves may occur (presumably due to a magnesium deficiency) but it was corrected by additions of nitrogen and potassium. Leaf analysis showed that a high level of magnesium was found in the leaves only when both nitrogen and potassium were added. Under the conditions of the experiment and the soil that was used, it appears that the low magnesium content is an indication of generally low nitrogen and potassium content.

(Project I-74-b)

Poinsettia Root Rot Can Be Controlled

Four years' work on the problems of commercial greenhouse men in controlling root rots on poinsettias has been completed. It is felt that a part of the problems involved may be due to the fact that the field-grown plants used in producing the young plants originate in a limited area on the West Coast, and that any pathogens from such a source could quickly spread to greenhouses producing this crop.

One of the causal organisms (*Thielaviopsis basicola*) can be controlled by growing the plants in an acid soil (pH 4.5 to pH 4.8). Results have shown that although the poinsettia plants grow satisfactorily under acid soil conditions, 2 other pathogens (*Rhizoctonia solani* and *Pythium spp.*) may become more serious. Trials with the use of fungicides applied to the soil have not been entirely successful in effectively controlling these soil borne diseases.

Control of these diseases is based on the isolation of the field-grown stock plants from the young plants together with the treatment of all soil, pots, beds, benches, and equipment to render them free from the disease organisms. Steaming the soil and equipment has proven to be very effective, although certain chemical fumigants such as methylbromide or chloropicrin can be used.

Actual cases of stimulation of growth of plants by the presence of some of the fungi were observed under conditions where the fungi do not cause disease. The exact mechanism as to the cause of this stimulation is not known.

(Project I-74-b)

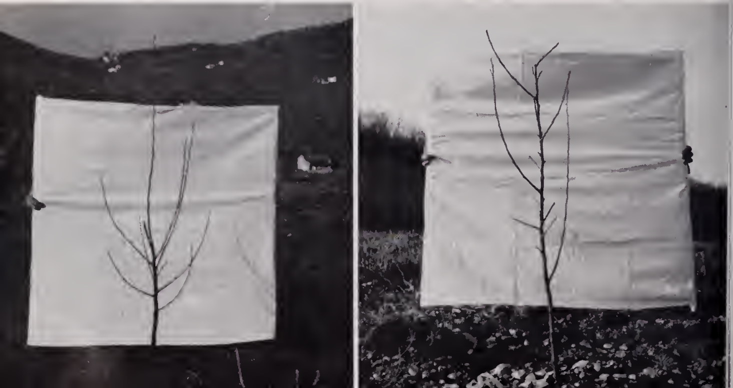
New Training Procedures Mean Stronger Apple Trees

The Delicious apple tree is noted for the narrow crotch angles produced. These often result in considerable breakage under the stress of a heavy fruit load or high winds later in the life of the orchard. In addition, standard training procedure in Maryland orchards is such that insufficient spacing of major limbs is allowed so that most of the leaders of the mature tree appear to originate at approximately the same area or level around the trunk.

If this condition is to be avoided, proper tree training must be carried out in the earliest years of the life of the tree. By the end of the second or third year at the latest, the main leaders should be selected and established.

It has been standard practice in newly-planted Maryland apple orchards to cut the tree whip back to a height of 36 to 42 inches before the first growing season has begun. Most of the major scaffold system of the tree is selected at the end of this first growing season, and everything else is cut off. This system produces a tree with major laterals arising over a vertical distance on the trunk of not more than about 20 inches, so that resulting leaders are crowded. Also, the crotch angles on the uppermost leaders tend to be narrow and therefore weak.

A new system of training the young apple tree is being tested by the Maryland Station whereby the newly-planted whip was headed at 4½ feet before growth began. After several inches of growth appeared, the several uppermost branches were removed by summer pruning, thereby



Delicious apple trees pruned after first growing season. *Left:* standard heading at 36 inches at planting time. Note crowding of branches along the main stem: *Right:* Headed at 54 inches at planting, headed again in June. Note the wide spacing of major branches. Inter-scaffold shoots in this method are deliberately cut back, but not entirely eliminated.

eliminating the narrowest crotch angles on the tree. After the first growing season was completed, 3 to 4 major scaffold limbs were selected. Instead of removing all inter-scaffold limbs as is commercial practice, these inter-scaffold shoots were headed back to subordinate them to the major shoots selected. In this way the lower, wide crotch angles were kept growing outward in the second season, and foliage provided by inter-scaffolds aided in more rapid development of the tree. Trees so handled are now in the third growing season, and show every indication of maintaining a stronger crotch system. Moreover, since greater length was left on the original whip, major leaders are more properly spaced along the trunk and no crowding is indicated for future years.

(Project L-74)

Prospects Brighter for Peach Thinning Spray

While it is possible to spray-thin peach trees with caustic compounds applied during the blossoming period, Maryland orchardists continue to practice costly hand thinning during June and July because the post-bloom frost hazards are too great to risk thinning until all danger from frost is over. Previous work by the Maryland Station on all materials reported to be effective thinners when sprayed up to a month after bloom has found these chemicals to be completely unsatisfactory.

In 1956, 25 new organic chemicals were tested for thinning activity on the peach. Each chemical was sprayed on Halehaven limbs at concentrations ranging from 5 to 625 parts per million. All sprays were applied 27 days after full bloom, or well after the danger from frost was over. Of the group tested, 10 compounds resulted in very good thinning of the fruit without adverse effects on fruit or foliage. At harvest time the fruit was of excellent size and quality, and showed none of the malformations in shape that so frequently accompany applications of hormone compounds to this fruit. These 10 chemicals will be tested in full orchard experiments in 1957.

(Project L-74-b)

Does Mulching Conserve Orchard Soil Moisture?

Maryland fruit growers want to know whether or not various mulches will conserve soil moisture by eliminating competition from weeds and cutting down on evaporation from the soil surface. Soil moisture under hay mulch, sawdust mulch, sod, and clean cultivated orchard soil was measured in 1956 by means of a soil moisture measuring apparatus which gives readings at 6-inch intervals down to the 24-inch depth.

When measurements were begun on May 1, soil moisture was at field capacity at all depths under all soil treatments. Depletion after this date was marked under the sod. Measurements under the sod showed that soil moisture was reduced rapidly at the 6 and 12 inch depths, but more slowly at the 18 and 24 inch depths.

Depletion under the mulches and the clean cultivated plots, however, proceeded much more slowly. Little difference was found between the various depths under these 3 treatments. Soil moisture remained at field capacity under the hay mulch until the early part of June, while moisture under the sawdust mulch and the clean cultivated areas remained high, but less than field capacity. Under the sod, however, moisture was very much lower than all other treatments in early June.

Throughout the rest of the season, differences were not marked as heavy rainfall occurred during June, July, and August. This work is being continued to record the performance of mulches during a more normal growing season when rainfall during the hot summer months is usually deficient.

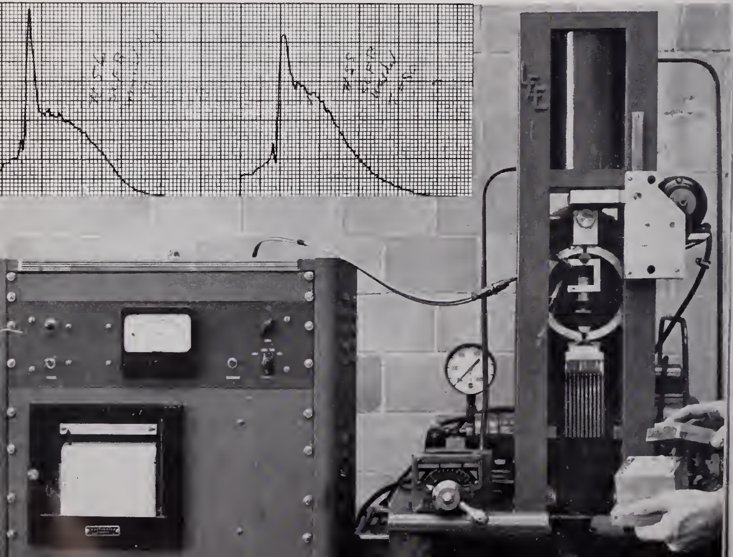
(Project L-74)

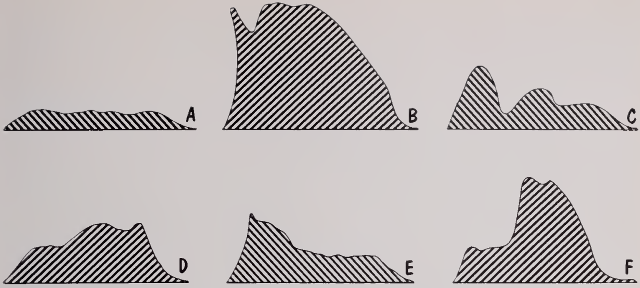
Electronic Recording Shear-Press Developed

Since the shear-press was introduced, it has found increasing use in both research and commercial organizations. This has largely resulted from increased emphasis on physical measurements of food quality where previously only human sensory tests were used. Applications have ranged from evaluating varieties to determining quality for cost determinations.

Results of these tests were obtained in terms of maximum pounds of force required to compress, shear, or cut through a sample of test material. In addition to not furnishing a continuous permanent record of force variation, this system was subject to a certain degree of error from failure

A recording attachment to the shear-press provides an opportunity for obtaining detailed information on quality of horticultural products. Inset: Curve at left is typical of a sample of sweet corn low in starch, but high in skin toughness. Curve at right is typical of sweet corn high in starch, but with a tender pericarp (skin).





Some characteristic time-force curves obtained with the recording shear-press on asparagus. A = uniformly tender asparagus; B = uniformly tough asparagus; C = tough stalk at bottom of sample; D = tough stalk at the top of sample; E = several increasingly tough stalks at the bottom of sample; F = several tough stalks at the top of sample.

to catch the maximum point indication of the guage hand.

The present work was chiefly concerned with modifications and additions required for electrical indicating and recording. In addition to reducing reading errors, additional information about the quality of the sample can be obtained from a strip chart recording of force variations. From the area under the curve, the pressure required for the test blades to pass through the sample can be calculated.

Work with asparagus indicated that not only average quality, but uniformity of quality may be determined from these "work" curves. Work now in progress indicates that starch content and skin toughness of sweet corn, thus far determinable only by means of chemical analyses, may be obtained in a matter of seconds from an examination of such curves.

(Project Q-58-f)

Use Shear Press to Determine Fiber in Canned Beans

Under certain growing conditions, green beans tend to develop excessive amounts of fiber, which is objectionable to the consumer to such an extent, that the Food and Drug Administration has set a standard of quality that canned green beans labelled as fancy, or even standard in quality, may not contain more than 0.15 percent fiber. In order to be certain that they comply with this law, canners must determine the fiber content of each lot of beans by a tedious chemical procedure. A more rapid chemical procedure has been developed at this station, but this method too, is too cumbersome for routine quality control operations.

During the past year a procedure was developed which makes possible the use of the shear-press for indicating the degree of fibrousness of raw beans for processing. The key to the procedure lies in the fact that the bean pods must first be deseeded before they are loaded into the shearing cell of the instrument. The entire test requires about 5 minutes. Results, in terms of pounds force, are closely correlated with fiber content. Several processors who utilized the procedure as a basis for accepting or rejecting lots of raw beans, report that the procedure eliminated the chance that their processing material did not meet the quality requirements.

(Project Q-58-f)

Develop Objective Method for Grading Tomatoes

In order to manufacture canned tomatoes and tomato products profitably, canners must be provided with raw tomatoes which contain a certain amount of red color, and are free from any number of defects. If a satisfactory grading procedure were available, the processor would be in a position to pay the grower a premium for the kind of tomatoes which he needed, and the grower would have a guide for the quality of tomatoes which would provide him with a premium.

Previous work at this station established the nature of the relationship between tests of quality on the raw materials and the quality of the finished product. Thus the information for setting up a complete grading procedure was available. This was tried out successfully on a pilot plant scale at several processing plants, with the indication that lots of raw tomatoes scoring high (on the basis of this grading system) yielded the desired quality finished product.

The grading procedure is based on: a determination of percent culls, by reference to color photographs; trimming loss as determined by the number of tomatoes in the sample requiring trimming; and color as measured by an electronic color difference meter.

(Project Q-58-f)

Develop Formula for Predicting Consistency of Cream Style Corn

Consistency of cream style corn is controlled by the proper blending of raw corn, water, sugar, starch and salt. Predicting consistency after processing and storage, when it is ready to go into the hands of the consumer, has long been a problem of the cream style corn packer. Recent research work shows consistency at the time of filling the container is highly correlated (0.90) with consistency after processing and storage. The product has a tendency to thicken with greater durations of storage, up to about a year. In general, filler consistency values of about 9 Adams consistometer (165°F) gave consistency values after 90 days of around 11.0, which were considered top fancy.

After 2 years work it became evident that there was considerable variation in the way samples developed their final consistency. It was found that maturity of the corn had considerable effect on the juiciness or thickness of the final product. To cope with this problem a nomograph was constructed from the following multiple regression equation: Consistency 90 days $= 5.44 - .143W + 1.18S + .471C$. From this equation and its accompanying nomograph, the packer can determine the proper percentages of water and added starch to put with the raw corn in the blending tank to come out with the proper consistency after processing and storage.

(Project Q-58-k)

pH Adjustment Minimizes Color Losses in Canned Tomatoes

Results of this 3 year study show that very little can be done in the field to improve the color of canned tomato products. Special emphasis was given practices carried out in the pilot plant and laboratory for improvement of quality.

Heat application during sterilization was the most important single factor involved in the loss of color during processing. This study indicated that the thermal sterilization value could be safely reduced by pH adjustment to about 4.1 with citric acid, providing proper sanitary conditions accompany the production of the juice. Such pH alteration, if proved to be accepted by the consumer, could significantly improve the grade of the canned juice.

(Project Q-58-i)

Develop Taste Panel Method for Evaluating Off-Flavor

Recent research at the University of Maryland and 5 other agricultural experiment stations in the Northeastern region has developed a quick, reliable method for evaluating off-flavors in fruits and vegetables caused by pesticides.

Briefly, the procedure calls for scoring the samples against a known marked standard sample using a $+2$, $+1$, 0, -1, -2 scale, in which $+2$ is better than standard in flavor, $+1$ equal to standard in flavor, 0 below standard in flavor, no detectable off-flavor, -1 slightly off-flavor, and -2 definitely off-flavor. Samples of each treatment (up to 10) are presented in random fashion, replicating 4 times, to a large group of persons of unknown efficiency. This group is then screened and judges who show ability to duplicate their evaluations and show differences in treatments, where present, are retained and asked to evaluate another set of the same samples. Analyses of variance may be used to determine the magnitude of differences among treatments using the latter group of judges.

Panel efficiency may be measured in terms of the number of individual tastings required for demonstrating statistical significance at the percent level. This is accomplished by use of "Sample Number Ratio" (SNR) multiplied by the number of tastings used (N). SNR may be obtained by the following equation:

$$\text{SNR} = \left\{ \frac{\text{LSD } 1\% \text{ for treatment means}}{\text{Range for treatments}} \right\}^2$$

(Project Q-58-o)

Vegetable Varieties Compared

Variety trials are designed to find those varieties that: (1) are best adapted to the latest improvements in farm machinery, (2) will produce high yields for the grower, (3) are suited to the plant operations and quality standards of the processor and (4) will be satisfactory to the consumer.

Sweet Corn

KVF 54-65 produced the highest yield of cut corn in the 1956 sweet corn trial. Canned quality for whole kernel pack is good. It is acceptable for cream style. NK-199 and Longchief were comparable in yield and canned quality. Longchief had a superior cob shape, and NK-199 had the best flavor. Golden 60, with a deep golden color and high percent cutoff, is an acceptable variety.

Snap Beans

Tendercrop, formerly 1831-9, is an outstanding freezing variety, well adapted to mechanical harvesting. Breeding Line C-12-6, soon to be released by Mississippi Agricultural Experiment Station, is a flat podded bean that develops fiber slowly. The outstanding white seeded varieties were: Corneli 14, Harvester and B 3076. All three are suitable for mechanical harvesting and snip well. Corneli 14 is a dependable bean, particularly under adverse weather conditions. It retains a satisfactory color after processing. Harvester, 4 to 5 days later than Corneli 14, has very straight, uniform pods.

Three snap bean varieties, showing setting behavior (left) and plants after picking with the mechanical harvester (right). Of the 3 varieties shown here, Harvester is the most suitable for mechanical harvesting.

Lima Beans

Early Thorogreen, Clark's Bush and the new downy mildew resistant lines, US 155 and 255, were selected from 13 varieties of baby lima beans as best adapted to Maryland conditions. Baby Fordhook limas produced high yields and possessed high quality when frozen and canned. They are 5 to 8 days later than Baby Limas. Viner speeds must be reduced to prevent unnecessary splitting of the beans of this new variety.

Peas

Satisfactory yields were obtained, at the low fancy and high extra standard stages of maturity, from the varieties Erickson Perfection, Resistant Early Perfection 326 and Hardy. Hardy matures rapidly in the field and cannot be expected to hold more than a day in the fancy stage if temperatures are high. Erickson Perfection has a smaller pod than is usually associated with an early perfection type. The size is deceptive of the actual stage of maturity and pre-testing is recommended. All three have better canned quality than the standard variety, Pride.

Spinach

A large number of short and long season, savoy and semi-savoy hybrid lines were tested in cooperation with

Conventional drilling of peas and fertilizer versus precision drilling. The darker green appearance of peas on the right is due to a heavy stand of weeds resulting from fertilizer placed with conventional drill. Fertilizer which stimulates weed growth, is not dribbled through the soil by the precision drill (left), but accurately placed 3 inches below the soil surface.

Dr. H. A. Jones of the Plant Industry Station, Beltsville. Two savoy and 3 semi-savoy lines were selected for further study.

Sweet Potatoes

As a result of the sweet potato variety trials, Okla. 52 has been released under the name of Oklamar. It shows promise particularly as an early market variety. It produces a high early yield and has very good color and quality.

Cabbage, Cauliflower and Lettuce

In tests in the mountain area of the state, Marion Market and Bonanza were the highest yielding early cabbage varieties. They were free from cracked heads. Green Acre, Resistant Detroit and Medium Copenhagen were slightly earlier cauliflower varieties with excellent yields. Snowball Y, Snowball Imperial, and Snowcap have been the outstanding varieties at several planting dates, ranging from mid-May to mid-June. No variety of lettuce has proved satisfactory due to high losses from bottom rot.

(Project Q-74)

Asparagus Growth Rate and Fiber Studied

Freedom from objectionable fibrousness is a major factor in quality of asparagus. In studies of conditions which affect the amount of fiber in the shoots, it has been found that nitrogen applications during the harvest season have little or no effect on rate of growth or development of fiber in the shoot.

Measurement of several thousand spears during the harvest season has shown that the average daily growth from time of emergence until the spears are 7 inches tall is about 2 inches.

Using the "snap point" test to determine the portion of the spear that is free from fiber, it has been found that spears cut at a height of 7 inches will have a snap point about 5¼ inches from the tip. Taste panel tests have shown that there is very seldom any objectionable fibrousness in the tip above the snap point. However, it was also found that an approximately ¾ inch segment below the snap point was judged to be free from objectionable fiber in the majority of instances.

The amount of fiber at a given distance from the tip of the shoot did not appreciably change during the harvest season, although, of course, the rate of growth per day was greatly influenced by temperature.

(Project Q-77)

Potash Increases Sweet Potato Yield but Decreases Dry Matter

Tests using the chloride and sulfate forms of potash for sweet potato fertilization have shown that the chloride source is slightly more efficient in increasing yields.

It was also found that increasing the rate of fertilization with potash from either source resulted in lower dry matter content of the sweet potatoes. It is therefore apparent that the potassium ion rather than the associated anion is responsible for the increased moisture content of sweet potatoes grown under high rates of potash fertilization. Storage tests failed to show any detrimental effect of the high potash fertilization on storage behavior.

It was found that an undesirable softness of processed samples in a syrup pack was associated with high rates of potash fertilization.

(Project Q-79-f)

"Air-Conditioned" Storage Helps Sweet Potatoes

The optimum temperature for storage of sweet potatoes has been found to be from 55 to 60 degrees F. During warm periods in the fall and after April 1 storage house temperatures are apt to be well above this range. As a result, greater storage losses occur and excessive sprout development may take place.

Installation of an air conditioning unit in an experimental storage room resulted in improved storage quality. Weight loss in storage was greatly reduced. Sprouting was negligible and baking quality of the sweet potatoes after 8 months' storage was much better than under usual storage conditions.

(Project Q-79-g)

Pectic Substances in Sweet Potatoes Vary

The pectic constituents of many fruits and vegetables are closely associated with changes that take place during ripening and storage. They may also have a pronounced influence on the processing characteristics of the product.

A study of the pectic substances in sweet potatoes showed that there was a distinct varietal difference at time of harvest with percentages ranging from 3 to 6 percent on a fresh weight basis. During curing and storage the amount of pectins decreased and the ratio of the more soluble fractions increased.

Processing resulted in a partial breakdown of the pectic substances. It is believed that this change in the pectic materials accounts in part for the undesirable softness of processed sweet potatoes and may explain why processing immediately after harvest results in a firmer product than when processing is delayed until after storage.

(Project Q-79)

Cauliflower Nutrition Studied

Cauliflower plants were grown in sand culture in the greenhouse at low, medium, and high levels of nitrogen, calcium, and molybdenum in all combinations.

Best growth was obtained when nitrogen was supplied at a concentration of 13.5 and calcium at 4.5 milliequivalents per liter. Molybdenum gave best results at 0.06 parts per million. An upward curling or cupping of the leaf margins resulted from too little molybdenum. Plants receiving the low calcium level developed chlorotic spots along the leaf margins with marked downward curving or hooking of the leaf tip. This condition was most severe and growth was much reduced when plants received a high level of nitrogen in combination with low calcium.

(Project Q-79-h)

Careful Parent Selection Aids Sweet Potato Seed Production

More than 2400 sweet potato seeds, involving 432 parental combinations, were produced in the greenhouse in the winter of 1956-57. Analysis of the performance data indicates that an average of 24 seeds were obtained for each 100 pollinations. The seed yield varied from none to as high as 200 seeds per 100 pollinations among the different combinations. Combinations involving Sunnyside, Tinian, Nemagold, Oklamar, and 3 Maryland seedlings as the male parent were very good. Combinations in which Oklamar or 3 Maryland seedlings were used as the female parent resulted in good seed yields. Proper selection of parent stocks should result in higher combining ability and higher seed production, thereby reducing the cost of a breeding program with sweet potatoes.

(Project Q-81-b)

Sweet Corn Breeding and Variety Testing

Sweet corn breeding continued under a Northeastern Regional Project (NE-32) in cooperation with 6 other state agricultural experiment stations, and several commercial seed companies. The objectives are as follows: (1) to conduct a uniform variety trial every year; (2) to develop F_1 sweet corn hybrids through the utilization of cytoplasmic male sterility; and (3) to study the inheritance of genes which restore pollen fertility to cytosterile lines.

Results of last year's uniform variety trial indicate (1) of the 6 early maturing hybrids under trial, N.J. 106 was rated excellent and Golden Beauty performed poorly at all locations. In Maryland, North Star was undesirable.

Of the 6 medium maturing varieties observed, N.J. 101 and Seneca Arrow were superior at all locations, whereas S-5234 was undesirable because it is late and has a smaller ear than other varieties in its maturity group.

Of the 8 late maturing canning varieties, N.K. 199, LoChief, and Victory Golden were rated superior at all locations. Seneca Chief performed poorly at all locations.

At this Station, F_3 segregations from a cross between a cyto-sterile line and a ts_4 linkage tester line have supplied additional evidence that a pollen restoration gene is located on chromosome 3_1 approximately 1 unit from the ts_4 *gene*. Several chromosome 7 linkage tester lines have restored pollen completely in crosses with several cyto-sterile lines ($C106^t$ & $WF9^t$). The search for the locations of additional pollen restoration genes will continue and composites obtained from cooperators in NE-32 will be inbred and included in the cyto-sterile program.

(Project Q-81-c)

Irrigation of Snap Beans and Cucumbers Pays

Supplemental irrigation has proven highly valuable in increasing yields and improving market quality of vegetable crops. In experimental tests covering a period of 3 years, snap bean yields were increased an average of about 70 percent over those not irrigated. Only 1 out of 7 plantings of snap beans failed to show marked improvement in yield from irrigation. In terms of quality, pods were larger, more desirable in shape, and contained lower percentages of seed and fiber.

Cucumber yields from irrigated plots averaged nearly 50 percent higher than those not irrigated over the 3 year period. In 2 seasons, response to irrigation was very good. In 1956 moisture needs were rather well supplied by rainfall during the critical period of production. Cucumbers from irrigated plots also showed improved quality. They were of a darker green color, straighter and more desirable in shape, giving a higher percentage of marketable fruits.

(Project Q-83)

POULTRY

The research work in the Department of Poultry Husbandry is classed roughly into four general fields: nutrition, breeding, physiology, and marketing. Of these four areas of work, there is more emphasis placed on nutrition than on any other. Yet it is felt that important contributions are being made in other fields.

The goal of all the research projects is to ultimately help the poultryman to produce better poultry eggs and meat with less cost. Research in the field of processing and marketing is being expanded, and will receive increasing attention in the future.

Broiler Chickens Tolerate High Levels of Fat

Three additional broiler field tests have been conducted involving the addition of various fats up to levels of 15 percent of the ration. In these tests, growth rates have been improved slightly when compared with that of control broilers fed all-mash rations containing lower levels of fat. In 2 of these trials, pelleting of the low fat rations also tended to improve growth rate. The amount of feed required to produce a pound of broiler was progressively reduced as the level of fat included in the ration was increased. The improved feed conversion, however, has been proportional to the increased energy potency of the ration in all tests. Pelleting of these rations had no effect on feed conversion.

In field trials, tallow, yellow grease, and hydrolyzed animal and vegetable fats have given similar results when the feeds are provided free choice. In battery trials, however, where various fats have been compared with starch as an energy source for chicks receiving suboptimal levels of energy, corn oil has been found more effective on a weight basis than animal grease or hydrolyzed animal and vegetable fat. This, however, has been found only with restricted levels of energy intake.

(Project M-35-1)

Metabolizable Energy Values Determined

Studies have been initiated to develop improved methods of measuring energy values of feed ingredients and to determine more fully the energy requirements of chickens. Although this work has only recently been initiated, the metabolizable energy values of corn starch (dry basis) and corn oil have been determined (1760 and 3900, respectively). A new method, developed at the University, which measures the net energy value of feedstuffs (corrected for nitrogen equilibrium) is also being studied.

(Projects M-35-1, M-54)

A bomb calorimeter being used to collect data on the energy content of a feed.

New Approach in Study of Protein Adequacy

A new technique for studying the amino acid or protein adequacy of practical broiler rations has been used to determine the order in which amino acids are limiting. This involves dilution of a practical type broiler mash with corn starch to give rations with progressively lower protein levels (ranging from 21.6 to 15.1 percent) without any change in the amino acid make-up of the protein. Amino acids were then added in amounts estimated to render each of these rations adequate, considering the differences in their energy levels. The National Research Council amino acid requirements for the chick were used as a guide. The estimated required amount of each essential amino acid was determined by computing the grams of each of these amino acids per therm or productive energy of the rations, assuming that the recommended dietary requirements were applicable to rations containing 900 Calories of productive energy per pound.

As the protein level of the ration was lowered (C/P ratio widened), growth rate and feed efficiency were decreased unless amino acid supplements were added. Amino acid supplementation of rations having C/P ratios (calories of productive energy per 1 percent crude protein) of 46 or 50:1 fully restored both growth rate and feed efficiency but was only partially effective in rations with wider C/P ratios. This work is being continued with the full expectation that protein can be used much more efficiently if the amino acid balance and adequate levels of all essential amino acids are maintained.

(Project M-35-i)

Unidentified Growth Factor Studies Continued

Practical studies with both chickens and turkeys have been conducted during the past year in which the need for sources of unidentified growth stimulatory factors has been determined. In two field studies involving turkey broilers, the addition of dried brewers' yeast, dried corn distillers' solubles, dried molasses distillers' solubles, fermentation solubles and dried whey failed to improve either growth rate or feed conversion when added to practical rations. These rations did contain, however, sources of the "fish factor" and the supplements tested were being used to determine whether or not additional factors were required. Studies with chicken broilers conducted this year, involving fish meal and crab meal, confirmed earlier work showing that broiler chicks do require sources of the "fish factor." This response to either fish meal or crab meal was obtained in rations containing either 0 or 10 percent added fat.

Studies with chicks involving purified diets have been used to study the possible carry-over effect of these unidentified factors from the hen through the egg. In assaying egg yolks from different maternal sources fed complete versus all-plant type rations, no differences were obtained in chick growth assays. However, egg yolks from each source improved the growth rate of the chicks by approximately 11 percent. This is comparable to the response which is obtained from other supplements.

Studies with turkeys involving purified diets have continued to show very marked responses, ranging from 40 to 50 percent, when a mixture of fish solubles, corn distillers' dried solubles, dried whole whey, dried molasses distillers' solubles, and distillers' dried yeast is added. The ash of this mixture improves growth rate by approximately half that obtained with the complete supplement. Some progress has been made in studying the chemical properties of the active principle with a view to concentration and isolation.

(Project M-35-g)

Antibiotic Dips Studied as Means of Preserving Egg Quality

The storage of market eggs has long constituted a major problem since the product is perishable. One of the most common causes of spoilage of eggs which are held under commercial conditions of storage is the microorganism *Pseudomonas fluorescens.* This organism produces a greenish yellow pigment which gives a characteristic fluorescence under ultra violet light. This condition is sometimes called "green rot."

Recently, a new application of antibiotics has been introduced to industry which involves the dipping of poultry into solutions of the tetracyclines. This treatment has been shown to significantly prolong the shelf life of dressed poultry; and consequently, a similar process has been tried on unwashed eggs. Preliminary experiments have been performed on eggs dipped in solutions containing 20 and 50 ppm of chlortetracycline. After 21 days of storage under commercial conditions, approximately 80 percent of the untreated eggs and 2 percent of the dipped eggs (20 ppm) showed fluorescence when the interior portion of the shell was exposed to ultra violet light. When the higher concentration was used, no fluorescence was observed in the dipped eggs.

Further studies are in progress to determine quantitatively the amount of antibiotic which will persist on the shell surface under commercial conditions of storage. Other antibiotics will be studied from the standpoint of their effects in preventing "green rot" spoilage and preserving egg quality.

(Project M-46)

Continue Microbiological Assays for Unidentified Growth Factors

Trichomonas gallinae, a protozoan isolated from the pigeon nasal passages, requires at least 3 unidentified factors for growth in an otherwise completely synthetic medium. The 3 factors are found in each of the 5 feedstuffs used in the chick and poult unidentified factor work.

Identification of the protozoan factors with the poult and chick factors awaits further purification and characterization of the poultry growth factors. If a relationship can be shown, the microbiological assays will be of value in speeding the isolation of the poultry factors. If no relationship can be established, the isolation of the protozoan factors may be of interest, since they may be required by animal cells.

One factor is found in the serum of different animals, as well as in some feedstuffs. The factor speeds fermentation of maltose by the trichomonads. This factor is also found in fractions of human serum which are required by human cancer tissue cultures. The factor could conceivably then be useful in all kinds of tests employing tissue cultures; i.e., cancer research, virus antigen production, etc.

The other two factors required by the trichomonas are found in trypsenized Casein and as a contamination in ribonucleic acid. The casein factor is probably a peptide. The factor connected with ribonucleic acid may be composed of two parts. Further work is being done to characterize these factors.

(Project M-48)

Vitamin B_{12} Metabolism Studied in Chick Embryos

Fundamental research in embryological development through the use of antimetabolites is of value because it will tell us how cells differentiate into specific tissues and organs. The work being carried on in the department has this in view. A number of compounds related to the benzimidazole portion of vitamin B_{12} has been injected into fertile eggs before incubation, or at different times during the incubation period. Two of these compounds caused a high number of embryo deaths. The deaths in many instances were due to specific malformations of the nervous tissue or the blood system. The compound, 2-ethyl-5-methylbenzimidazole, produced malformations in 1- to 2-day-old embryos and 1,2-dichloro-4,5-diaminobenzene mainly produced anomalies of the beak, eye and brain in 6- to 10-day-old embryos. The severity of the damage was parallel to the amount of the compound injected.

In order to determine which specific functions were interferred with, several metabolites were injected singly, along with the inhibitor. Vitamin B_{12} partially reversed the toxicity of the inhibitors when injected prior to incubation. Riboflavin, adenine and guanine, which are also related to the benzimidazole compounds, were only slightly, or not at all, effective in reversing this toxicity. Other mechanisms must therefore be involved in the production of the malformations. In other words, vitamin B_{12} and other metabolites would be needed to protect the embryo against the inhibitors, thus allowing normal development of the embryo.

Other workers have shown that 1,2-dichloro-4,5-diaminobenzene inhibits the synthesis of vitamin B_{12} and riboflavin in microorganisms and 2-ethyl-5-methylbenzimidazole inhibits the *in vitro* synthesis of porphyrin in avian erythrocytes and inhibits influenza virus multiplication. Further studies on the nature of the inhibition will help us to understand cell and tissue growth and development.

(Project M-49)

Fat and Protein Levels Studied in New Laying House

A new laying house composed of 32 pens, each with a capacity for 25 hens, was completed in December, 1956. An experiment with White Leghorn hens was started in January involving corn-soybean meal type rations and rations containing some meat scraps and crab meal. Within each of these series, one-half of the hens receive no added fat while the remainder of the hens receive 10 percent added fat in their ration. Superimposed on these variables were 4 different Calorie-protein levels ranging from 56 to 73:1. These rations involve protein levels ranging from 13 to 19 percent. In addition, 8 pens of hens are allowed to select between 2 series of feeds, one of which contains 10 percent added fat. Another series of hens is also permitted to choose between feeds containing widely different levels of protein.

Of interest so far is the fact that these laying hens have consistently consumed approximately 9 times as much feed containing 10 percent fat as they did of the control ration which contained no added fat. This has been true for each experimental period and for each of the 8 pens involved. Also, the hens receiving the high fat ration appear to be consuming less feed per dozen eggs, this difference being related primarily to the difference in energy content of the ration. As far as effect of protein

Laying hens being given free choice feeding of regular laying mash and laying mash containing 10 percent added fat.

levels, fat addition, or source of protein in the ration on egg production, no differences have been noted.

(Project M-35-m)

Alkaline Phosphatase Concentration Related to Egg Production

A study is being started to determine what will occur if one breeds for a high or low level of a substance known to be related to a characteristic of economic importance, such as egg production.

The substance selected has been the alkaline phosphatase level in blood, since there is already some evidence that it is related to egg production. Further evidence at this station has confirmed that high alkaline phosphatase concentration is associated with high egg production, but not with shell thickness, albumen quality, egg weight, and body weight.

It was also shown that within the group of chickens used there were differences between families in their alkaline phosphatase level. Therefore, males and females from families with high levels were selected and mated together. The alkaline phosphatase level of progeny of these matings will be determined when these birds reach sexual maturity and will be compared to a random-bred control.

A low line is not being developed in this study since there is little interest in showing whether or not egg production can be lowered by breeding for low alkaline phosphatase concentration.

(Project M-32-m)

Lines Differing in Cholesterol Level Developed

Studies of a fundamental nature are being conducted in an attempt to determine the importance of differences in the cholesterol level of the blood serum of chickens. Two methods are being used. One is to detect any statistical relationship between cholesterol level and a number of important characteristics such as egg production, body weight, and shell thickness. This is done by using individual values obtained with a single population of birds. The second method is to develop genetic lines that differ greatly in cholesterol level and then to determine in what other respects these lines also differ.

There are theoretical reasons for believing that the cholesterol level in blood serum may be of considerable practical importance since cholesterol is an important substance in the formation of a number of hormones that are known to control egg production.

Using the first method, the statistical approach, there apparently are no significant relationships of cholesterol level to body weight, egg production, shell thickness, albumen quality, and egg weight. The second method of developing high and low lines is also being employed. Differences in the 9-week cholesterol level of different families were found and this information was used to select birds to set up matings for a high and a low line. The genetic influence has been further verified since the progeny of these matings differed in their cholesterol level. Matings will be continued in an attempt to obtain greater differences between the high and low lines, since the differences are too small at this time to expect measurable differences in characteristics of economic importance.

(Project M-33-e)

New Productive Strain of Turkeys Used for Crossbreeding

A strain of medium-sized white turkeys has been developed at the University of Maryland and is currently being distributed to interested turkey breeders. These birds are the result of 7 years of breeding and selection during which time the major emphasis has been placed upon the reproductive capacities of the birds. Rate of growth and body conformation, though, have received some attention, particularly during the last one or two years.

The growth rate of the new turkey, the Maryland Medium White, was compared with the Beltsville turkey at a trial at the Salisbury substation. In this trial, the Maryland Medium White and Beltsville turkeys weighed 9.3 lbs. and 7.7 lbs., respectively, and had feed conversion rates of 3.48 and 2.54, respectively.

A new phase of the work has been undertaken this year, that of using this strain for the female parent in crossbreeding trials where the large Broad-Breasted Bronze turkey is used as the male parent. The goal is to utilize the high reproductive rate of the Maryland Medium White breed and at the same time capture much of the size and conformation qualities of the Broad-Breasted Bronze breed. This procedure, it is hoped, will give poults with the approximate size and conformation qualities of the Broad-Breasted Bronze much less expensively than they could otherwise be produced.

(Project M-34-e)

A hatcheryman examines a turkey of the new Maryland Medium White breed.

Strain of Birds Purified for Flightlessness

The project of developing a flightless strain of birds, previously described, has been continued. The strain of birds as now developed is nearly pure for the flightless condition and is relatively pure for dominant white. These birds mature normally and grow normally despite the lack of the 22 primary and secondary flight feathers, and are being distributed in a limited way to poultrymen within the State.

The genetics of the flightless condition have proven interesting in that the character does not behave as a recessive, nor as a dominant condition; that is, when flightless are mated to flightless, not all flightless progeny result; yet, at the same time, when flightless are mated to normal, some flightless progeny appear. It is felt that if sufficient selection were practiced, the character could be induced to behave as a dominant character so that when flightless were mated to normal the progeny would be all flightless.

The strain of birds as developed has reasonably good egg production for a heavy breed and grows relatively rapidly.

(Project M-33-i)

Relationship Between Egg Production and Molt Studied

One of the rather standard seasonal responses in birds is the annual molt. All birds, wild and domesticated, molt all or most of their feathers at least once a year, and some birds more frequently.

The physiological background causing molt is not well understood, but it has been known for many years that birds seldom lay and molt simultaneously. A project has been under way to study the cause of molt and how it may be possible to artificially induce molt.

Progesterone, one of the female sex hormones, has been shown to be quite effective in inducing molt. This not only works well with chickens, but it has been demonstrated that it will also cause turkeys to molt.

By inducing molt in the latter part of the summer, hens can be induced to lay well during the fall season of high egg prices. The same procedure has been tried with turkeys, but the turkeys fail to return to egg production in the fall. It thus appears that in so far as turkeys are concerned some factors other than the molt are responsible for halting production.

(Project M-32-l)

Heat and Cold Affect Egg Production and Egg Quality

A number of experiments have been conducted to find the effect of rapidly increasing and decreasing environmental temperature. In each trial, 15 White Leghorn and 15 New Hampshire hens were used and were kept in hen batteries.

In the experiment on high temperature, the temperature was raised at a rate of 4° F. per hour until a temperature of 100° F. was reached for New Hampshires, and 105° F. for the White Leghorns. After 2 days at these high temperatures, the temperature of the room was lowered at the same rate. Under the conditions of these studies, there was little effect on egg production but there was a pronounced decrease in shell thickness, egg weight, and feed consumption, and a pronounced increase in albumen height. The same results were obtained when temperature was raised and lowered at a much slower rate.

In the experiments on rapid lowering of environmental temperature, the temperature was dropped 2° F. per hour until it reached 10° F. for White Leghorns and 0° F. for New Hampshires. At 10° F. there was a drop in egg production lasting 1 to 2 days, and at 0° F. there was a cessation of egg production for about 1 week. There was no noticeable change in egg size, shell thickness and albumen height, but there was a drop in feed consumption. At the lowest temperatures used for White Leghorns and New Hampshires, up to one-half of the comb, as well as some of the toes, were frozen; these frozen parts later dropped off. Most of the birds whose combs were frozen, stopped laying 3 to 4 weeks after the experiment, even though their egg production was normal up to that time.

(Project M-50)

Storage of Cock Semen Studied

Studies of a fundamental nature have been carried out to determine the proper salt concentration and pH for poultry semen diluents. Such information should be of benefit in future research attempting to dilute or store semen *in vitro.*

Semen was diluted with nine parts of diluents of different composition and was stored for 3 to 7 hours and then inseminated into a number of hens to test its fertilizing ability.

When a wide range of different salt concentrations was used, the optimum conditions were when the freezing point depression of the solutions was between −.607 and −.639° C. Outside of this range, fertility decreased gradually with increasing or decreasing salt concentration.

The effect of pH was studied by mixing isotonic solutions of disodium phosphate and monosodium phosphate in different proportions. In three trials, there was little difference in fertility in solutions with pH's ranging from 6.5 to 8.0. Above and below this range, fertility dropped off markedly. The pH of undiluted semen was found to decrease more rapidly at 25° and 40° C. than at 10° C.

These experiments have shown that it is important to control pH when storing semen, and explain some of the poor results obtained previously in attempts to store semen.

The effect on the degree of dilution of semen with the sodium phosphate buffer was studied with fresh semen. Fertility of semen diluted 1 to 50 was lower than that diluted 1 to 5, 1 to 10, and 1 to 20; but there was little difference in fertility obtained at the latter 3 dilutions. In all cases, fertility of the undiluted semen was highest. This indicates that semen cannot be diluted as much as 1 to 5 with the sodium phosphate buffer without some loss of fertility.

(Project M-33-j)

RURAL SOCIOLOGY

During the 1956-57 year, research in rural sociology developed in new directions. Because of these developments this report has the nature of a report of progress rather than a report of final accomplishment. A substantial harvest of reported research will be realized in the next fiscal year.

Regional Population Reports Being Prepared

This department's cooperation in the Northeastern regional population committee has resulted in our being selected to prepare 3 regional reports in the series of publications authorized by the regional committee. The first report is in final manuscript phase and deals with population change, composition and vital rates for the Northeast, and its 2 divisions, for the 1900-1950 period. The other 2 reports will deal with migration and selected aspects of metropolitan development. Tabulations have been completed for both the latter reports and text materials will be prepared during 1957-58.

Complete Delaware Population Change Study

Another phase of regional cooperation occurs when active stations take on work along regionally-prescribed lines for stations whose personnel do not actively participate. In this context Maryland workers have a manuscript nearly completed which deals with Delaware's population change between 1940 and 1950 with special reference to selected metropolitan—non-metropolitan analyses. By this means, interstate cooperation advances and we obtain published information for those states who do not have personnel assigned to demographic research.

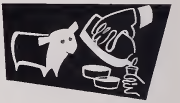
Study Retirement in Rural Community

Data for a study of retirement in a rural community—New Windsor—have been collected, coded and tabulation is in process. This study constitutes one of the new directions accepted by sociologists of this station. Our demographic analyses led to the conclusion that retirement and aging, and particularly retirement in rural areas posed problems of social and economic nature which warranted investigation.

Complete Data Collection for Rural Development County

Finally, during 1956-57 the data collection phase for a study in a Rural Development pilot county was completed. This study will provide benchmark data for future study in the county and guidelines to extension workers and others who will be involved in planning economic and social development of this county and other areas in similar situations.

VETERINARY SCIENCE



Research in animal and poultry disease, previously reported under the heading of Animal Pathology, is now included under the broader designation of Veterinary Science. Some staff members are now assigned to research only, whereas others are concerned with diagnostic and teaching work, along with research.

New project outlines have been prepared on all studies which are to be continued. Several new projects have been initiated. Emphasis is placed on the study of animal and poultry disease of economic and public health importance.

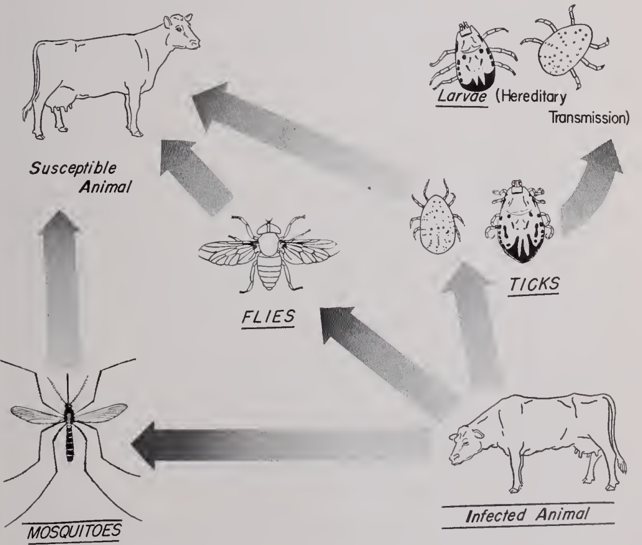
Wild Birds Believed to be Reservoirs of Equine Encephalitis

Equine encephalitis, or sleeping sickness, has been a serious disease of horses in Tidewater Maryland for many years. In 1933, over 900 horses perished from this disease on the Eastern Shore. Last year, over 75 fatal cases occurred in horses in that area. Although it was once thought that horses served as a source of infection for other horses and man, it is now believed that wild birds are the reservoir of the disease. Epidemiological studies suggest that various species of mosquitoes become infected in feeding on wild birds and may transmit the infection when they subsequently bite horses and human beings. Research work is in progress to determine geographical distribution and prevalance of eastern equine encephalitis and to develop sensitive, accurate tests to diagnose the infection. Future studies may involve testing of mosquitoes and wild birds to detect the virus during epizootic periods.

(Project D-57)

Anaplasmosis Survey Completed

Anaplasmosis is a disease of cattle characterized by anemia, depression and loss of weight. It is transmitted by biting insects and by injudicious use of surgical equipment applied to bovines.



The mode of transmission of anaplasmosis.

A survey of Maryland cattle for anaplasmosis has been completed. Of 17,721 animals tested, 5.01% were positive on the complement-fixation test. In general, the greatest number of infected animals appears to be in the region of the Chesapeake Bay and large rivers. These results are not unexpected since biting insects that feed on cattle are quite prevalent in tidewater areas. This project is being terminated for the time being.

(Project D-50)

Investigate Immune Serum for Combatting Newcastle Disease

In the absence of effective drugs that can be brought to bear against Newcastle disease, poultrymen are forced to rely on preventive vaccines for control of the disease. Since vaccines are somewhat slow in taking effect, the possibility of employing immune serum to combat the ailment is being investigated. In preliminary experiments, it has been shown that immune serum (rabbit) delays onset of the disease. Further experiments are in progress to determine the practicability of using immune serum produced in various animals as a means of controlling outbreaks of the malady.

For several years, experimental work has been conducted for the purpose of adapting Newcastle virus to the hamster and employing tissues of that animal to produce a mild vaccine for prevention of the disease in poultry. The object of such a vaccine would be to impart protective immunity in poultry flocks without the danger of a severe postvaccination reaction. In recent experiments, a vaccine prepared from the 330th hamster passage was found to be nonpathogenic for chickens injected intramuscularly. The vaccine did not, however, produce a desirable degree of immunity in chickens vaccinated at 1 month of age.

(Project D-52)

Discontinue Study of Drugs For Blackhead of Turkeys

New drugs have been found effective against blackhead of turkeys. Several congeners of the Nitrofurans are known to exert preventive action against the disease. In studying an arranged series of this group of drugs, more light has been thrown on their mode of action. Several drugs are now available for control of this protozoan ailment of turkeys and chickens. Investigational work with this problem is being discontinued for the time being.

(Project D-55)

Study Bacteria in the Respiratory System of Poultry

In connection with the study of "air-sac disease" in domestic poultry, it is necessary to know what kind of microorganisms normally inhabit the respiratory system. This investigation has shown that Gram-positive cocci and rods inhabit upper respiratory passages (nose, sinus, windpipe) and sometimes the lungs. On the other hand, air sacs in the healthy bird, usually are free of bacteria. One flock included in this study had previously been affected with "chronic respiratory disease." Some birds from this group were found to harbor, in the air sacs, pleuropneumonia-like organisms and also *Escherechia coli,* a species normally found in the digestive tract.

Additional studies with a tetracycline antibiotic (panmycin) have shown this drug to be somewhat effective as a therapeutic agent when administered a week after artificial exposure to the disease. Treatment was of little value if delayed for 2 weeks from the time of exposure to the causative organisms.

(Project D-59)

Continue Investigations on Brucellosis of Cattle

A survey has been made during the past year of more than 100 fetuses obtained from cows killed in the Baltimore slaughter houses. The fetuses were removed aseptically from the *intact* uteri, and the organs and tissues were cultured on media and inoculated into laboratory animals. Brucella were isolated from 5 of the fetuses, and 4 of the 5 had been obtained from cows negative to the agglutination test. Another interesting finding was that all 5 fetuses had skin infection, and 2 of the 5 also harbored Brucella in 1 or more organs. In aborted fetuses, Brucella are most commonly found in the stomach contents; but no such isolations were made from the stomachs of these infected embryos. Additional findings along these lines may alter some of the concepts on brucellosis in cattle.

During the past year, work has progressed on the preparation of a vaccine designed especially for adult cattle, which will not confuse the diagnostic picture with persistent agglutination titers. A strain of Brucella, originally virulent, has been serially passed through embryonating eggs 120 times so as to have become modified to the extent that it is only mildly pathogenic for guinea pigs. From this strain of organisms a vaccine has been produced which seems to have the characteristics of a satisfactory immunizing agent. Additional data is expected to be acquired during the coming year on the efficacy of this vaccine.

More than 500 blood samples from cattle throughout the State have been tested in embryonating eggs during the last year for the presence of protective substances against Brucella. This data conforms to the results obtained on the 1000 samples tested previously. There appears to be little doubt, as judged from these results, that the serum from calfhood vaccinates gives greatest protection from 4 weeks after vaccination until the animal is 2 years of age. The serum of calfhood vaccinated cattle of 4 or more years of age showed little protection, if the animals had not come in contact with Brucella organisms to bolster their immunity. Sera from animals with titers of 1:100 or greater, invariably gave marked protection to Brucella-infected embryonating eggs. It is quite probable that some of these titers were due to infection, but many of them resulted from adult vaccination of some years previous.

If and when a standardized test can be developed for grading the protective qualities of the blood sera of cattle, it will be very useful in determining the presence of resistance to infection in individual animals. It will likewise furnish a measure of the average duration of immunity and will thus give some indication of the best time to select for vaccinations.

(Project D-46)

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PROJECTS

(These are projects and not publications available to the public.)

Department of Agricultural Economics and Marketing

Project
Number

A-18-aj—Farm Labor Requirements. R. A. Murray and K. N. Adams.

A-18-ak—Organization and Operation of Maryland Tobacco Farms. R. A. Murray and K. N. Adams.

A-18-al—An Economic Study of Maryland Dairy Farms. J. W. Wysong.

A-19-o—Conservation and Economy in Rural School Bus Transportation. W. P. Walker.

A-19-p—Factors Affecting the Cost of Certain Kinds of Insurance to Farmers. Sidney Ishee.

A-19-r—Impact of Maryland Highway Improvement Program on Agriculture. W. P. Walker and J. H. Dagher.

A-19-s—Effects of Maryland Tax System and Fiscal Policy on Farmers Tax Liability. W. P. Walker.

A-19-t—Capital Requirements in Agriculture. P. R. Poffenberger.

A-26-ah—Marketing Maryland Forest Products. G. M. Beal and B. R. Robertson.

A-26-al—Analysis of the Development of Farmer Cooperatives. P. R. Poffenberger, R. J. Beiter.

A-26-am—Consumer Purchases and Acceptance of Poultry Products Under Various Merchandising Practices. H. D. Smith and W. G. Langston.

A-26-an—Relation of Various Livestock Marketing Methods to Producer Returns. H. D. Smith and J. N. Smith.

A-26-ao—Quality and Volume Effects Upon Economies of Plant Operation in the Canning of Tomatoes, Corn and Peas in Maryland. Sidney Ishee and F. D. Gray.

A-26-ap—Supplies and Utilization of Milk for Non-Fluid Uses in the Washington, D. C., Milkshed. G. M. Beal and A. B. Jeffrey.

A-26-aq—Marketing Maryland Snap Beans. G. M. Beal and L. C. O'Day.

A-26-as—An Economic Study of Retail and Wholesale Flower Marketing. E. G. Taylor, D. J. Burns and P. R. Poffenberger.

A-26-at—A Study of Egg Marketing in Maryland. H. D. Smith and W. G. Langston.

A-26-au—Marketing of Maryland Sweet Potatoes. H. D. Smith and Ray Voelkel.

A-26-av—Marketing Margins as Associated with Expansion or Curtailment in Consumer Services. J. Dagher and C. C. Taylor.

A-32-f—Farm Tenancy and Leasing Arrangements in Maryland. P. R. Poffenberger.

A-32-h—Effect of Drainage Upon Crop Yields, Farming Practices and Land Utilization. P. R. Poffenberger.

A-33—Financial Arrangements in the Broiler Industry. H. D. Smith and J. B. Horne.

A-34—Economies of Scale and Factors Affecting Variations in Cost of Processing Fruits and Vegetables in Maryland. L. C. O'Day and Roger Burdette.

A-35—Buying Practices of Fruit and Vegetable Processors. G. M. Beal, Wayne Bitting and H. C. Stutts.

Department of Agricultural Education

T-4—The Role of Educational Campaigns in Removing Safety Hazards from Farms. M. Palmer Hopkins.

Department of Agricultural Engineering

R-11-d—Tobacco Housing. R. W. Carpenter, G. J. Burkhardt, P. N. Winn, Jr., E. W. Martin and O. E. Street.

R-11-e—Structures and Equipment for Tobacco Stripping. R. W. Carpenter, G. J. Burkhardt, P. N. Winn, Jr., E. W. Martin and O. E. Street.

R-16—Pneumatic Handling of Chopped Forage. R. W. Carpenter, G. J. Burkhardt, A. V. Krewatch, K. E. Felton, E. W. Martin and J. E. Foster.

R-17—Drying Shelled Corn with Unheated Air in Maryland. G. J. Burkhardt and R. G. Rothgeb.

R-18—Development of Equipment and Improved Methods for Harvesting Sweet Potatoes. G. J. Burkhardt and E. W. Martin.

Department of Agronomy

B-43—Soybean Culture and Varietal Improvement. R. C. Leffel and R. G. Rothgeb.

B-50—Breeding for Better Dent Corn. R. G. Rothgeb and staff assistants.

B-56-a—Red Clover Improvement. A. M. Decker, Jr.

B-56-g—Ladino Clover Breeding. A. M. Decker and T. S. Ronningen.

B-56-i—Breeding Orchard Grass for Maryland. T. S. Ronningen and A. M. Decker, Jr.

B-56-j—Pasture Species for Beef Production. A. M. Decker, Jr. and J. E. Foster.

B-56-l—Variety and Strain Testing of Forage Legumes and Grasses in Maryland. A. Morris Decker, Jr.

B-56-m—Seedling Establishment and Management of Legumes and Grasses. A. M. Decker, Jr., and N. A. Clark.

B-56-n—Alfalfa and Alfalfa-Orchard Grass Management. A. M. Decker, Jr.

B-56-o—Management and Fertilization of Established Grass and Grass-Legume Mixtures. A. M. Decker, Jr., and Mitchell Thompson.

B-58-c—Weed Control in Legumes. R. E. Wagner, J. A. Meade, T. L. Bissell and W. C. Hurlburt.

B-58-d—Influence of Environmental Factors on the Effectiveness of Several Carbamate Herbicides. P. W. Santelmann, J. A. Meade and Woodland Hurtt.

B-58-e—The Use of Chemical and Cultural Methods to Control Weeds in Field Crop or Turf Areas. P. W. Santelmann and J. A. Meade.

B-60—Tobacco Fertilizer Rates and Placement in Relation to Plant Population. O. E. Street, C. G. McKee, J. E. McMurtrey, Jr., J. H. Hoyert and G. A. Bourbeau.

B-66—Wheat Improvement for Maryland. R. G. Rothgeb, J. L. Newcomer and J. H. Axley.

B-67—Improvement of Small Grains for Feed. R. G. Rothgeb and staff assistants.

B-68—Effect of Rotational Practices Involving Various Legumes on the Growth, Quality and Composition of the Maryland Tobacco. O. E. Street, C. S. Britt, C. S. Slater, L. B. Nelson and B. L. Grove.

B-69—Breeding for Mildew Resistance in Winter Barley and Wheat. R. G. Rothgeb, staff and student assistants.

BOQR-84—Climatological Relationships to Plant Growth Employing Supplemental Irrigation. (In cooperation with Departments of Agricultural Engineering and Horticulture) O. E. Street, A. M. Decker, Jr., R. E. Wagner, C. W. Reynolds, L. F. George, P. N. Winn, L. B. Nelson, T. W. Edminster, H. H. Engelbrecht and M. L. Blanc.

N-10—Inspection and Examination of Seeds Produced or Sold in Maryland. J. L. Newcomer, M. H. Day, C. A. Schaetz, O. M. Kelk, E. P. Emack, and A. H. Ferguson.

O-45-b—A Study of the Comparative Availability of Phosphate Materials. H. B. Winant, R. P. Thomas and J. H. Axley.

O-48—Classification and Correlation of Maryland Soils with Special Emphasis on Morphology, Fertility and Conservation and Interdependence of these Factors. G. A. Bourbeau, Michael Redgrave and Ray Zarza.

O-49—Corn Yields as Influenced by Fertilizer Placement. J. H. Axley.

O-51—Alfalfa Fertilizer Practices. J. H. Axley.

O-54—Mineralogical Studies of Maryland Soils. G. A. Bourbeau, M. Bennett, V. Vallassis and J. Parker.

O-55—Study of Soil Tests to Improve Their Accuracy and Reliability. J. H. Axley and J. O. Legg.

O-56—Factors Affecting the Formation and Destruction of Soil Aggregates. E. Strickling, R. O. Gifford, M. Redgrave, O. Cohen and T. Olson.

O-58—Corn Stalk Rot Incidence as Affected by Various Rates of Fertilization. F. L. Bentz and S. E. Younts.

Department of Animal Husbandry

C-14—A Study of the Productiveness of Purebred Beef Cattle in Maryland. W. W. Green, J. E. Foster and John Buric.

C-14-a—Effect of Early Weaning on the Duration of Maternal Influences in Beef Calves. W. W. Green and J. E. Foster.

C-14-b—Type Classification as an Aid in Selection of Beef Breeding Cattle. W. W. Green, J. E. Foster and John Buric.

C-14-d—Group Versus Individual Feeding of Weaned Beef Calves. John Buric, J. E. Foster, W. W. Green and J. R. Sperry.

C-20—The Development of Superior Lines of Swine Based on Crossbred or Purebred Foundations. W. W. Green, J. E. Foster and J. H. Zeller.

C-21—The Effect of Specific Metabolites Upon Growth Rate and General Condition of Sheep. E. C. Leffel, W. H. Brown, J. E. Foster and J. C. Shaw.

C-23—A Study of the Effects of Protein Level on the Reproductive Performance of Female Swine. E. C. Wingert, W. W. Green and J. E. Foster.

C-24—A Study of the Presence and Control of Internal Parasites in Swine. F. C. Wingert, W. W. Green, J. E. Foster and J. R. Sperry.

C-25—A Study of Rumen Metabolism in Sheep. E. C. Leffel, W. H. Brown, J. E. Foster, J. C. Shaw and S. Lakshmanan.

C-26—Studies of the Protein and Energy Requirements of Growing-Fattening Swine. F. C. Wingert, E. C. Leffel, G. F. Combs and J. E. Foster.

C-27—A Study of Growth Promoting Properties of Certain Feed Adjuvants. F. C. Wingert and J. E. Foster.

C-28—A Study of the Effect of the Form in Which Feeds are Fed to Swine. F. C. Wingert and J. E. Foster.

C-29—A Study of the Effects of Method of Feeding and of Different Protein Supplements for Growing-Fattening Swine. F. C. Wingert and J. E. Foster.

Department of Botany

F-12—The Native Plants of Maryland, Their Occurrence, Distribution and Economic Importance. R. G. Brown.

F-15-b—Spontaneous and Induced Multiple Seedlings and Haploids of *Zea Mays Capsicum Frutescens* and Other Economic Plants and Their Use in Plant Breeding. D. T. Morgan, Jr., R. D. Rappleye, F. Campos and J. R. Brennan.

F-16—Cytological and Genetical Studies in Ornamental and Crop Plants, R. D. Rappleye, D. T. Morgan, Jr., P. B. Price, J. R. Brennan, and M. Herron.

F-17—Forest Tree Improvement by Chromosome Doubling of Haploid Sporophytes. R. D. Rappleye and M. Herron.

J-86-a—The Nature and Control of Sweet Potato Diseases Occurring in Maryland, Including Studies on Significance of Microbiological Antagonism. J. G. Kantzes, C. E. Cox and graduate assistants.

J-91—Evaluation of Fungicides for the Control of Diseases of Vegetable Crops. C. E. Cox, H. D. Sisler, L. O. Weaver, J. G. Kantzes, H. S. Potter, R. J. Lukens and B. C. Smale.

J-92—Development of Antibiotic Substances for Control of Plant Pathogenic Organisms. C. E. Cox, H. D. Sisler, W. H. Miller, T. Montee, Moustafa Abo-el-Dahab.

J-93—Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. O. D. Morgan, W. R. Jenkins, J. B. Wilson and assistants.

J-94—Selection and Development of Disease Resistant Varieties of Potatoes for Use in Maryland. C. E. Cox, J. G. Kantzes, H. S. Potter, L. O. Weaver and graduate assistants.

J-95—Development of Improved Strains of Maryland Tobacco Resistant to Diseases. O. D. Morgan, O. E. Street, Dr. Heggested and J. H. Hoyert.

J-96—Occurrence, Distribution, Biology and Non-Chemical Control of Plant Parasitic Nematodes in Maryland. W. R. Jenkins, R. A. Rohde, B. W. Coursen and D. P. Taylor.

J-97—Biology and Control of Nematodes Associated with Plant Diseases. W. R. Jenkins, R. A. Rohde and B. W. Coursen.

J-98—Identification, Characterization and Control of Certain Viruses Affecting Economic Plants in Maryland. H. D. Sisler, C. E. Cox, O. D. Morgan and W. H. Miller.

K-8-c—The Role of Trace Elements in Plant Nutrition. H. G. Gauch, R. W. Krauss, George Harrison and John Ambler.

Department of Dairy Husbandry

G-34—Chemical Changes in Milk Fat as Related to the Flavor of the Milk. Mark Keeney.

G-35—The Analysis of Dairy Products. Mark Keeney and R. Bassette.

G-37—Ketosis and Parturient Paresis in Dairy Cows. J. C. Shaw, S. Lakshmanan, R. F. Davis, A. C. Chung and C. Martinez.

G-38—The Physiology of Milk Secretion. J. C. Shaw, S. Lakshmanan, E. Mougey, Jeanne McCarthy and T. R. Lewis.

G-39—A Study of Factors Affecting the Availability and Utilization of Nutrients in Feeds and Their Influence Upon Body Composition, Growth and Milk Secretion. J. C. Shaw, R. N. Doetsch, E. C. Leffel, S. Lakshmanan, W. F. Williams, R. F. Davis, R. R. Robinson, T. R. Lewis, William Brown, James Holter, P. Jurtshuk, Jeanne McCarthy and R. Gibbons.

G-40—Influence of High Temperature Heat Treatment on Certain Physical and Chemical Properties of Milk. J. F. Mattick.

G-42—Methods of Processing and Other Factors Affecting the Quality of Ice Cream. E. A. Day.

G-43—The Metabolism of Acetate, B-hydroxybutyric Acid, Glucose and Other Carbon Compounds in Lactating Ruminants. J. C. Shaw, S. Lakshmanan, A. C. Chung, Jeanne McCarthy and R. D. McCarthy.

G-44—The Effect of the Farm Holding Tank Milk Procurement System Upon the Keeping Quality of Market Milk. J. F. Mattick and W. S. Arbuckle.

G-46—The Relationship of the Hypophyseal Growth Hormone and of the Pituitary-Adrenal System to the Productive Capacity of Dairy Cattle for Reproduction and Milk Production. J. C. Shaw, A. C. Chung, S. Lakshmanan and W. F. Williams.

G-47—Nutritive Evaluation of Forages. R. F. Davis, A. M. Decker and James Smith.

G-48—Flavor Quality of Concentrated Milk Products as a Factor in Milk Utilization and Marketing. Mark Keeney, R. Bassette and E. A. Day.

GC-45—A Study of the Causes and Prevention of Bloat in Ruminants. (In cooperation with the Animal Husbandry Department) J. C. Shaw, R. N. Doetsch, E. C. Leffel, R. F. Davis, S. Lakshmanan, W. H. Brown, R. J. Gibbons, P. Jurtshuk and J. J. McNeill.

Department of Entomology

H-29-k—The Drosophila Problem in the Canning of Tomatoes. L. P. Ditman and W. E. Bickley.

H-29-l—Chemical Control of Bean Insects: Evaluation of Commercial Treatments and Investigations of New Insecticides. L. P. Ditman, F. C. Stark and G .J. Burkhardt.

H-29-m—Chemical Control of Insect Pests of Sweet Corn. L. P. Ditman and F. P. Harrison.

H-35-a—Nursery Insects. The Euonymus Scale. W. T. Johnson.

H-35-b—Nursery Insects. Control of the Boxweed Psyllid *Psylla Buxi* (L). E. N. Cory and H. A. Highland.

H-35-c—Nursery Insects. Pests of Holly. E. N. Cory and H. A. Highland.

H-40-a—Biology and Control of Tobacco Insects. The Tobacco Horn Worm. H. S. McConnell.

H-40-b—Biology and Control of the Green Peach Aphid on Tobacco. H. S. McConnell.

H-43—Biology and Control of the European Corn Borer. H. S. McConnell.

H-46-d—Studies on the Efficiency of Fixed Boom Low Volume Sprayers. L. P. Ditman, F. P. Harrison, G. J. Burkhardt, C. E. Cox and F. C. Stark.

H-46-e—To Develop a Quick and Approximate Method for Determining Presence of Insecticides on Fresh Crops for Processing. L. P. Ditman and J. T. Whitlaw.

H-48—Control of the Codling Moth. W. E. Bickley, C. Graham and E. R. Krestensen.

H-50—The Biology and Control of the Pests of Commercial Floriculture. The Control of Orchid Pests. E. N. Cory and H. A. Highland.

H-56—Patuxent Project on the Effect of Soil Conservation Upon Insect Populations. H. B. Owens and L. P. Ditman.

H-58—A Taxonomic Study of the Coccid genus Toumeyella and Some Closely Related Genera. H. S. McConnell.

H-59—Bionomics of Some Freshwater *Aedes* Mosquitoes in Maryland. W. E. Bickley, and J. T. Whitlaw, Jr.

H-60—Biology and Control of Nut Weevils. L. P. Ditman and W. T. Johnson.

H-61—The Biology and Distribution of *Macropsis* Trimaculata Fitch. W. E. Bickley and E. R. Krestensen.

H-62—Alfalfa Weevil: Life and Seasonal History, Ecology and Control. E. N. Cory, T. L. Bissell, H. L. Dozier and D. G. Kissinger.

H-63—Ecological Studies of Mosquitoes in Freshwater Impoundments in Maryland. W. E. Bickley, J. T. Whitlaw, Jr., and graduate students.

H-64—An Evaluation of the Effectiveness of Commercial Insect Control Practices on Canning Crops. L. P. Ditman.

H-65—Formulation of Sprays for the Home Garden. L. P. Ditman.

H-66—The Effectiveness of Some Chlorinated Organic Insecticides When Applied to the Soil. L. P. Ditman.

H-67—Factors Influencing Spray Deposits on Some Vegetable Crops. L. P. Ditman, F. P. Harrison and J. T. Whitlaw.

H-68—An Annotated List of Nemic Parasites of Insects. W. T. Johnson.

QH-58-o—Evaluation of Possible Off-Flavors Resulting from the Application of Chemicals on Soils and Growing Crops. (Cooperation with Department of Horticulture). R. C. Wiley, Amihud Kramer, L. P. Ditman and F. P. Harrison.

H-69—Identification and Control of the Various Species of Mites Causing Damage to Apple Orchards. Castillo Graham and E. R. Krestensen.

H-70—Study of the Seasonal History, Parasites and Control of the Unspotted Tentiform Leaf Miner, *Callisto* (Parornix) *geminatella* Pack. W. E. Bickley, E. R. Krestensen and Castillo Graham.

Home Economics—Department of Foods and Nutrition

Y-1—Interrelationships in the Metabolism of Different Levels of Protein and Fat in the Diet of College Women. Pela Braucher, H. W. Nilson, Virginia Dawson, Helen Thompson and Genevieve Watkins.

Department of Horticulture

BOQR-83—Engineering, Soil and Plant Aspects of Supplemental Irrigation. (In cooperation with Agronomy and Agricultural Engineering) J. H. Axley, E. Strickling, O. E. Street, M. L. Blanc, R. E. Wagner, K. E. Felton, G. J. Burkhardt, C. W. Reynolds and F. C. Stark.

I-74-a—Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Hydrangeas and Azaleas. J. B. Shanks and C. B. Link.

I-74-b—Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Cut Flower Crops. C. B. Link and J. B. Shanks.

I-79-h—The Relationship of the Mineral Nutrients and of Nutrient Levels to the Growth and Flowering of the Azalea Under Greenhouse Conditions. C. B. Link and J. B. Shanks.

I-79-i—The Balance and Intensity of Inorganic Nutrient Elements as they Affect the Growth, Flowering and Quality of *Hydrangea Macrophylla* Thunb. Under Greenhouse Conditions. J. B. Shanks and C. B. Link.

L-73—Adaptation of Fruit Varieties and New Seedlings to Maryland. I. C. Haut, D. H. Britton, A. H. Thompson, F. J. Lawrence and J. W. Hull.

L-74—Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson, L. E. Scott, F. J. Lawrence, B. L. Rogers, S. H. Todd, and I. C. Haut.

L-74-b—Chemical Thinning of Apples and Peaches. A. H. Thompson, B. L. Rogers and E. A. Stahly.

Q-58-f—Development of Objective Grades and Standards and Quality Control Methods for Vegetables. Amihud Kramer, R. C. Wiley, B. A. Twigg, G. Backinger, Eugenia D. Sokoloff, J. Mason, R. W. Decker, and A. T. Sidwell.

Q-58-k—Development of Specifications for Canned Food Quality. R. C. Wiley, Amihud Kramer and assistants.

Q-58-n—Suitability of New Varieties of Horticultural Crops for Canning and Freezing. W. L. Hollis, B. A. Twigg, F. C. Stark, Amihud Kramer, L. E. Scott, R. C. Wiley, W. A. Matthews and H. S. Todd.

Q-58-p—Improvement in the Quality of Canned Apple Slices and Sauce Through Studies of Processing Treatments and Chemical Constituents. R. C. Wiley, A. H. Thompson and Amihud Kramer.

Q-58-q—Bulk Packaging and Shipping of Raw Vegetables. Amihud Kramer and L. E. Scott.

Q-74—A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. W. L. Hollis, F. C. Stark, L. E. Scott, C. W. Reynolds, A. A. Duncan, W. A. Matthews and B. A. Twigg.

Q-77—Crop Management Studies with Vegetable Crops. F. C. Stark, W. L. Hollis and R. R. Dedolph.

Q-79-b—The Mineral Levels and Interrelationships of Mineral Nutrients in Fruit Plantings in Maryland. L. E. Scott, A. H. Thompson, B. L. Rogers, I. C. Haut, D. Heinicke, D. Dunlop and E. A. Stahly.

Q-79-c—Influence of Nutrient Intensity and Balance on the Quality and Physiological Defoliation of Cantaloupes. F. C. Stark, W. A. Matthews and C. W. Reynolds.

Q-79-e—Influence of Nutrient Intensity and Balance Upon the Yield and Quality of Tomatoes. F. C. Stark, W. A. Matthews and C. W. Reynolds.

Q-79-f—Mineral Nutrition of the Sweet Potato with Special Reference to Cation Interrelationships. L. E. Scott, A. A. Duncan and F. C. Stark.

Q-79-g—Changes in Chemical Composition of the Sweet Potato During Development, Storage and Processing as Related to Quality of the Final Product. L. E. Scott, W. A. Matthews, F. C. Stark and Esam Ahmed.

Q-79-h—Influence of Nutrient Intensity and Balance on the Growth, Yield and Quality of Cauliflower. C. W. Reynolds and F. C. Stark.

Q-81—Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. C. Stark and W. A. Matthews.

Q-81-b—Sweet Potato Breeding and Selection with Particular Reference to Quality and Resistance to Cracking. F. C. Stark, W. A. Matthews and L. E. Scott.

Q-81-c—Sweet Corn Breeding with Particular Reference to the Utilization of Cytoplasmic Male Sterility in the Production of F_1 Hybrid Seed Corn. R. J. Snyder and F. C. Stark.

Q-82—Tomato Breeding and Selection with Particular Reference to Greater Resistance to Cracking and to Late Blight. F. C. Stark and W. A. Matthews.

Q-84—Effect of Modified Atmosphere Upon the Storage Behavior of the Sweet Potato. L. E. Scott and T. L. Senn.

Department of Poultry Husbandry

M-32-l—Study of Factors Influencing or Controlling the On-Set of Molt. C. S. Shaffner, Paul Harris and Mary Juhn.

M-32-m—Genetic Differences in Alkaline Phosphatase Concentration of Blood Sera as Related To Differences in Egg Production and Egg Quality. F. H. Wilcox and C. S. Shaffner.

M-33-e—Genetic Control of Serum Cholesterol Level. C. S. Shaffner, W. H. Wilcox, F. Cherms and P. C. Harris.

M-33-i—Development of a Flightless Strain of New Hampshire Chickens. C. S. Shaffner and G. D. Quigley.

M-33-j—Fertility Studies with Chickens and Turkeys. F. H. Wilcox and C. S. Shaffner.

M-34-e—Selective Breeding of Medium Sized Turkeys for Improvement of Economic Qualities. C. S. Shaffner and G. D. Quigley.

M-35-g—The Requirement of the Growing Chick for Newer Members of the Vitamin B Complex. G. F. Combs, W. C. Supplee, O. D. Keene and G. L. Romoser.

M-35-i—Amino Acids in Poultry Nutrition. G. F. Combs, G. L. Romoser, D. F. Middendorf and E. J. Robel.

M-35-l—Development of Improved Rations and Feeding Methods for Broiler Production. G. F. Combs, G. L. Romoser, J. L. Nicholson, W. E. Donaldson, E. J. Robel and D. L. Blamberg.

M-46—Market Quality of Eggs as Influenced by Antibiotic Treatments. G. L. Romoser and L. E. Elliott.

M-47—Antibiotics, Arsenicals and Related Compounds in Poultry Nutrition. G. L Romoser, G. F. Combs and J. L. Nicholson.

M-48—Microbiological Studies Pertaining to Poultry Nutrition. Mary S. Shorb and Pauline Lund.

M-49—Vitamin B_{12} and Chick Nutrition. Mary S. Shorb, Unabelle B. Blackwood.

M-50—The Effect of Rapid Changes in Ambient Temperatures on Egg Production. C. S. Shaffner, W. H. Wilcox, G. D. Quigley and A. C. Campos.

M-51—Development of Improved, Objective Methods for Detecting Meat Spots in the Hen's Egg as Related to Quality in Egg Marketing. N. V. Helbacka.

M-53—A Study of the Relationship Between High Ambient Temperature and the Shell Thickness of Market Eggs. N. V. Helbacka.

Department of Sociology

S-3—Studies in the Population of Maryland. R. K. Hirzel and W. C. Rohrer.

S-3-2—Population Change in Maryland and the Northeast. R. K. Hirzel, W. C. Rohrer and Maren Lockwood.

S-4—Studies in Social Organization with Application to the Maryland Agricultural Extension Service. W. C. Rohrer and Jewell Fessenden.

S-5—Farmers Attitudes Toward Farming: A Comparative Study of Farm Enterprises. W. C. Rohrer and Nelson LeRoy.

Department of Veterinary Science

D-46—Investigations on Brucellosis of Cattle. A Study of the Protective Quality of Blood Serum on the Development of Brucella—Infected Embryonating Eggs. Cornelia M. Cotton, Gertrude M. Jones and Carolyn Swann.

D-50—Anaplasmosis of Cattle. Herd Surveys by Counties in Maryland. L. J. Poelma and Arnold Johnson.

D-52—Newcastle Disease Investigations with Particular Reference to Vaccine Modifications and Virus Study. H. M. DeVolt, A. Gabuten, A. P. Holst, R. L. Reagan, S. C. Chang and F. S. Yancey.

D-53—A Study of Rumen Fermentation and Ruminant Metabolism with Emphasis on Their Relation to Ketosis. R. B. Johnson.

D-55—Investigations with Infectious Enterohepatitis (Blackhead) of Turkeys H. M. DeVolt, A. P. Holst and A. R. Gabuten.

D-56—Experiments with Erysipelas in Turkeys. H. M. DeVolt, A. P. Holst and A. R. Gabuten.

D-57—Epizootiology of Equine Encephalitis in Maryland. R. J. Byrne, Frances S. Yancey and S. C. Chang.

Station Staff

AGRICULTURAL ECONOMICS

G. M. Beal, Ph.D., Prof. Agr. Econ.
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R. L. Regan, Prof. Vet. Virology
J. R. Sperry, D.V.M., Assoc. Prof. Vet. Sc.

CHANGES IN PERSONNEL

Appointments

Clifford Taylor, Ph.D., Visiting Professor, Agricultural Economics, September 1, 1956
J. W. Wysong, Ph.D., Assistant Professor, Agricultural Economics, October 3, 1956
S. E. Younts, Ph.D., Assistant Professor, Agronomy, March 1, 1957
J. B. Wilson, M.S., Assistant Professor, Botany, September 1, 1956
R. A. Paterson, Ph.D., Instructor, Botany, October 15, 1956
E. A. Day Ph.D., Assistant Professor, Dairy Husbandry, October 16, 1956
W. F. Williams, Ph.D., Assistant Professor, Dairy Manufacturing, February 11, 1957
N. V. Helbacka, Ph.D., Assistant Professor, Poultry Husbandry, November 7, 1956

Resignations

T. S. Ronningen, Ph.D., Associate Professor, Agronomy, July 21, 1956
H. B. Winant, M.S., Assistant Professor, Agronomy, October 3, 1956
E. N. Cory, Ph.D., Professor and Head, Entomology, August 1, 1956
J. H. Ryan, B.S., Associate Professor and Agricultural Editor, November 3, 1956

FINANCIAL STATEMENT—July 1, 1956 to June 30, 1957

	Federal Funds			
	Amended Hatch	*Regional Research*	*Agr. Marketing Title II*	
	$ 2,057.92		$ 648.61	
Appropriation 1956-1957	324,339.08	87,130.00	7,500.00	
TOTALS	326,397.00	87,130.00	8,148.61	
Receipts from sources other than Federal 1956-57				*For Agr. Investigations**
State Appropriations for Agricultural Investigations				$542,874.95
Special Endowments, Fellowships and Grants				69,986.54
Sales and Miscellaneous				147,967.04
				760,828.51
Balance brought forward July 1, 1956				87,025.18
TOTAL				$847,853.69
Expenditures:				
Personal Services	194,710.27	52,412.91	4,909.24	495,765.35
Travel	9,857.00	1,634.79	710.46	9,827.85
Transportation	290.69	32.91		611.68
Communication Service	442.28	320.59	12.01	2,728.57
Rents and Utility Services	727.56	781.95		6,301.39
Printing and Reproduction	3,157.26	85.27		2,860.48
Other Contractual Services	9,754.48	7,739.29	5.50	58,969.20
Supplies and Materials	52,959.18	14,285.43		121,984.38
Equipment	30,313.28	5,493.11		21,598.92
Lands and Structures	24,185.00			13,820.40
Contributions to Retirement				
Taxes and Assessments				918.06
	$326,397.00	$82,786.25	$5,637.21	$735,386.28
Balance June 30, 1957		4,343.75	2,511.40	112,467.41
TOTALS	$326,397.00	$87,130.00	$8,148.61	$847,853.69

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* *Including Offset Funds.*

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In addition to state and federal funds, the research program of the University of Maryland Agricultural Experiment Station has received support during the year from many public, private and industrial organizations and individuals. It is regretted that space does not permit recognition of all sources of help, but the cooperation of all is herewith gratefully acknowledged.

Visitors will be welcome at all times and will be given every opportunity to inspect the work of the Agricultural Experiment Station in all its departments.

The bulletins and reports of the Station will be mailed free of charge to all residents of the State who request them.

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